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THE EVOLUTION OF THE HORTICULTURIST[1]

By Professor T. H. McHATTON

GEORGIA STATE COLLEGE OF AGRICULTURE

IT was at the very dawn of our modern era, if we accept the historian's division of time, that Columella wrote:

> I can not enough wonder why they who desire to learn eloquence are so nice in their choice of an orator, whose eloquence they may imitate; and they who search after a knowledge of surveying and numbers look out for a master of the art they delight in; and they who are desirous of some skill in dancing and music are exceedingly scrupulous in their choice of one to modulate their voices or to regulate the motions of their bodies; also they who have a mind to build send for architects, masons and carpenters; and they who resolve to send ships to sea send for skillful pilots; they who make preparations for war call for men of war; and everyone sends for a person from the society and assembly of the wise to form his mind and instruct him in the precepts of virtue; but husbandry alone, which, without all doubt, is next to and, as it were, near akin to wisdom, is in want of both masters and scholars.

One who peruses the voluminous writings of Columella can but marvel at the keen insight he displayed concerning things agricultural and horticultural. So true was his statement that rural culture was looked down upon that this history of the very heart of Rome, this economic treatise of the times, has been pigeonholed and forgotten by the very ones who should have used its gems of living philosophy in expounding the humanities that they so loudly preach are necessary in cultivating the human mind. Even in the time of Columella, agriculture and horticulture were as teachable as any other subject of the period, but, because the luxury-loving landlords saw fit to

[1] Presidential address before the American Society for Horticultural Science.

abrogate their responsibilities and to delegate the tilling of the soil to their less intelligent servants, agriculture became a sordid occupation and man saw little in it but sweat and toil. He lost sight of that cycle of life of which the soil is the basis; and there came to pass that condition of affairs so greatly feared by our wise philosopher; that is, agriculture had indeed become a sordid occupation, and now, nearly 2,000 years later, there are still living among us those who do not yet realize that of the words agriculture and horticulture, more than half are "culture."

History is of little value except in helping one predict the future. It took men almost twenty centuries to grasp some realization of the importance of agriculture, and it has taken the greatest economic crisis in the history of our world's civilization to crystallize that realization. I sometimes wonder if the phrase that we have heard so often repeated during the past twenty years concerning the "drudgery in the home" is the forerunner of a system of thought that will cause the abrogation of responsibilities and fetter man for another 2,000 years or more.

Horticulture was an amateur calling from the days of Columella to the middle of the nineteenth century; and even yet amateurs are occasionally found among apple and pear trees, or in gardens near cabbages and carrots, sometimes on lawns near clumps of shrubs or beds of flowers from whence they peep out upon the world with bright and shining eyes filled with happiness and contentment, their voices mellowed with the love of nature and the philosophy of living. It is a pity that the age of "internal combustion" has so beset them with "ologies" that they have practically disappeared, and unless the few remaining are carefully protected, this species will soon be counted with things historic.

This benign type of individual was so common during the middle of the nineteenth century as to deserve the name "vulgaris." Ever since the days of Rome they had been on the increase, receiving something of a setback during the "Dark Ages," but after that period of depression they emerged from the monasteries and rapidly increased in number, laying the basis for the establishment of schools and trades in Europe and the development of such aggregations of congenial souls as the American Pomological Society in this country.

These early amateurs were building the foundation of our profession and producing cyclopedic writings and rule books of culture in large numbers; so also were their close associates, the general farmers, laying the bedrocks from which were to spring much of our present-day agriculture.

Let us view for a moment the situation in this country about the middle of the nineteenth century. At the end of the seventeen hundreds this nation was mainly rural and producing just about enough for its needs, exporting some tobacco, cotton and rice. Horticultural products were all home grown and had only a very limited local market. Following the invention of the cotton gin, the opening of canals, the development of the railroads and the disruption of world economic conditions through the Napoleonic wars and our own War of 1812, commerce and industry developed. Thus we find the East industrialized, the South agricultural and the free lands of the West rapidly developing into a great grain and animal section. Agriculture had gone through the stage of home consumption, and the horticulturists were catching glimpses of extensive orchards and gardens in the future. Protective tariffs had been passed and the conflict between agriculture and industry had already brought on the Civil War, and the same conflict may, in the near future, bring some other great cataclysm to this nation.

Such conditions brought rural problems to the forefront in the minds of thinking men; mayhap they sensed the great industrial-agricultural conflict that was on and caught a glimpse of its future magnitude. Be that as it may, the Congress of the United States, in the midst of national strife, legislated into being a system of education that, through the land-grant institutions, would pay its dividends during the time of peace. Thus after eighteen hundred years was the lamentation of Columella fully answered—there were to be scholars and teachers of agriculture.

If 1870 is accepted as the approximate date at which these institutions really began to function, it is only fair that some estimate be made of what horticulture was at that time. Though there had been efforts at instruction in this subject in Europe and a few in America, the handling of it had been along apprenticeship lines; the teaching of a trade by rule of thumb, based upon a literature consisting of calendars and catalogues of varieties. Professional horticulturists, if we might call them that, were really managers of estates, or florists and gardeners about large centers of population. There were many amateurs and some several nurserymen also interested in the subject purely as home projects.

When one realizes that at the time of the passage of the Morrell Act botany and zoology were still in the systematic stage; bacteriology had not yet been born; genetics was still philosophy; and organic chemistry, though a lusty infant clamoring for recognition, had made little impression in learned circles; that physics had progressed mechanically, but the realms of heat, light and electricity largely remained unexplored; that the biochemist, the biophysicist, the

soil scientist, the phytopathologist, the entomologist and many others had not yet come into being; it is easy then to understand the attitude of the academic mind when horticulture and other allied agricultural subjects were raised to the dignity of a college curriculum. Such subjects were not teachable in universities, as they were not based on well-organized information and backed up by a literature centuries old—besides, they were merely trades and had no right to academic standing.

In the main this was largely true and was reflected in the organization of institutions with standards considerably below those set by the humanities. In the older states, already supplied with higher education, these new colleges were established separately; in others, they were connected with the budding university, and in still others they were destined to be the hub around which great institutions were to develop. In the beginning, they all had the ideal of preparing artisans in horticulture. The students were to go back to their orchards and gardens, increasing their production and bettering the living conditions throughout America. It was natural that such ideals should prevail, as there were really no well-established, well-understood horticultural facts; science had not, as yet, removed our profession from the realm of astronomy.

Things did not happen, however, as anticipated; departments rapidly expanded and demanded these trained artisans as teachers, and gradually there developed a different ideal of horticulture. The period of 1870–1890 was one of great activity in our field. The constant search for well-established facts and their organization into a body of teachable matter developed above all else the great fact that little was known. So noisy was the clamor for definite information and its dearth so apparent, not only in horticulture, but along all agricultural lines, that the Hatch Act found its way through the hoppers of Congress and gave us a new ideal of what a horticulturist could be.

Between 1890 and 1910, many more things happened to change our ideas of horticulture. The public still expected the product of the college to be an artisan, while the colleges themselves, the experiment stations and the rapidly expanding national Department of Agriculture recognized the demand for experimenters, teachers and scientists. The amateur was rapidly disappearing. There was, of course, still a lot of interest in the production of quality fruit about the homes, but the development of refrigeration and the railroads, into what we then considered rapid transportation, reorganized our industry. Extensive orchards spread themselves throughout California and the South; the vast vegetable fields of Texas and of Florida had begun to pour their out-of-season products upon the markets of the East. The experiment stations had amassed an enormous number of facts and the inquiring minds of the profession were asking questions that were vitally more fundamental than the date of planting or pruning. The sciences had taken hold of horticultural problems. Pasteur, Koch and others had conjured bacteriology into being. The problems of evolution had become things of every-day discussion. Botany had slipped from its classification era into embryology, physiology and more basic discussions. At the beginning of the century the work of Mendel had been resurrected from dusty archives, and horticulture was launched into its economic and scientific being.

In academic centers science was fighting the humanities for its place in the sun, and it was during this era that there came into being that new species called the "pure scientist," unsullied and untouched by practicality, but willing enough to use the public monies, appropriated so that science could render more productive and remunerative the basic industries of the nation. It is well to remember that the scientists who have written their names across the pages of history have been those who had advanced mankind and relieved humanity of its burdens. They are honored in direct ratio to the advancement civilization has received from their discoveries. All science is pure: it matters not whether it is digging into the sewers of a great city or studying the elusive perfume of a spotless lily.

During this period, the Adams Act came into being. We then found ourselves launched upon definite scientific studies, and, if we look back upon this time, those of us who were in it can well remember the trials and troubles we had in organizing experimental work upon a scientific basis. To my mind the passage of the Adams Act was one of the most beneficial things that has happened to the profession of horticulture as a whole. This act again changed our ideal of a horticulturist. The experimenter had become a scientist even more than a fruit grower, and for a while we laid away the idea of simple demonstrations, but this was not long, for it was realized that valuable information was not getting back to the farms where it could be profitably used and the Smith-Lever Act was the result.

This was rapidly followed by the Smith-Hughes Bill; a response to a demand for farmers and fruit growers on the soil which it was finally seen could not be met by the colleges, as estimates show that a large rural state requires in round numbers 4,000 new farmers annually. These acts brought into being other species of horticulturists, namely, men

with scientific training and practical ability who could teach in secondary schools or by demonstration in the rural districts and thus get back to the country information that it really needed. Also during this period of 1910–1920 the commercial horticulturist came to the forefront. He was found with railroads, spray companies, fertilizer companies, machinery companies, marketing organizations, and the like.

Since 1920 specialization has increased, and with the passage of the Purnell Act the economist has become important, injecting into our already complex organization other demands. Industry, in its selfishness and under artificial stimulation, had turned the United States from a rural into an urban nation, and the great industrial-agricultural conflict had practically throttled farming in its various forms before a realization was attained that the power, wealth and balance of trade of this country were in reality dependent upon the products of its soil and the labor of its rural population, which had for decades been producing against an impenetrable barrier of protection, for other interests, and forced to sell in open competition on the markets of the world. Is there any wonder that since 1920 the economical production and handling of our horticultural products have become prominent in our thoughts? The horticulturist can look with pride upon the fact that of the brotherhood of agricultural subjects his was the first to realize the importance of coordinating individual effort in projecting better methods of handling farm commodities; and, out of this experience of more than a quarter of a century, there should come to him the realization that he is better able to maintain himself under stress of modern conditions than other members of the rural fraternity; even though his advice has neither been sought nor listened to in the formulation of schemes and the passage of legislation intended to control the immutable laws of economics. It is a great pity, my friends, that money is not endowed with brains as well as power.

THE GEORGE EASTMAN RESEARCH LABORATORIES FOR PHYSICS AND CHEMISTRY

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

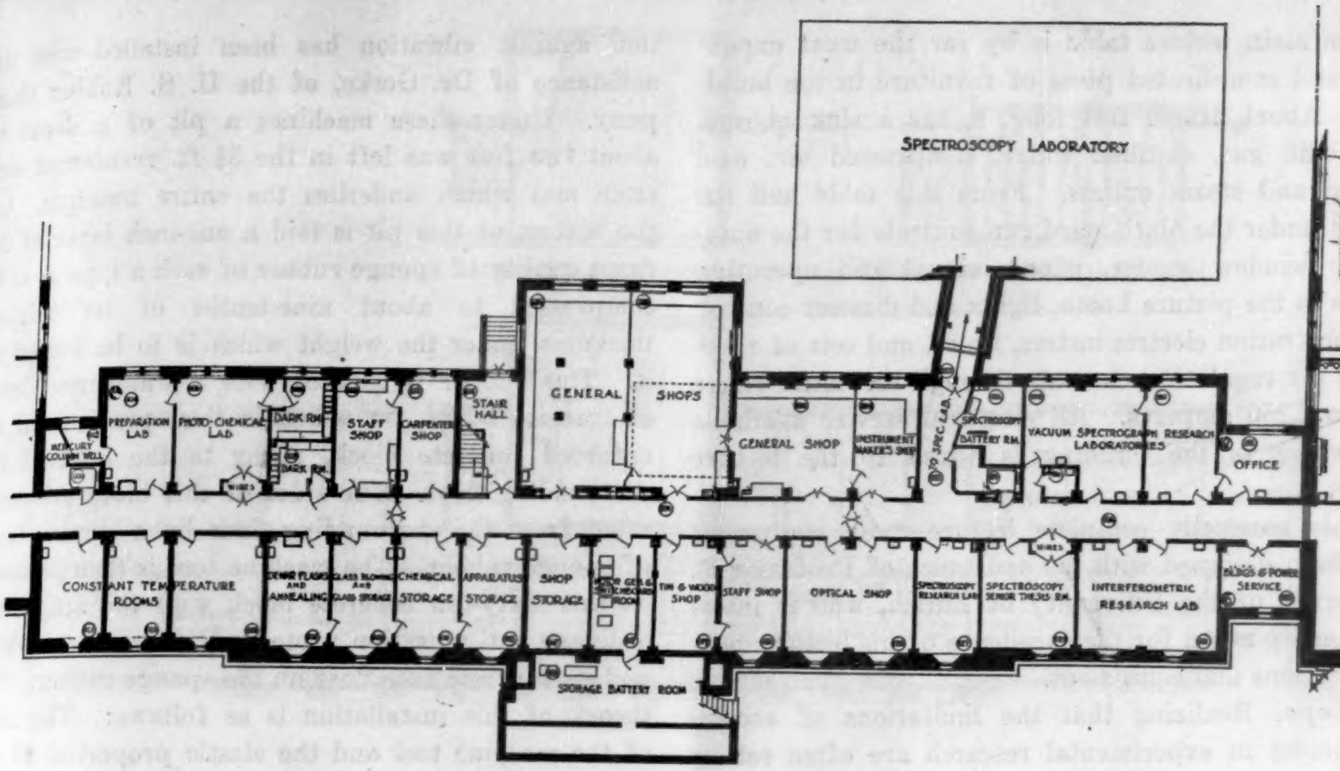
THE new research laboratories of physics and chemistry, which are now nearing completion at the Massachusetts Institute of Technology, are built in the belief that these fundamental sciences are destined to play an even more important rôle in our civilization than they have played during the past, for not only do they underlie all branches of engineering, but they are necessary to that sympathetic understanding and appreciation of modern life which is so important a part of present-day culture.

These laboratories are devoted entirely to advanced instruction and research and embody the most approved features, together with numerous new features of laboratory design. Briefly stated, these features are: rigidity and freedom from vibration; flexibility and completeness of electrical service; flexibility of internal arrangements; unusually adequate shop, lecture room and departmental library facilities; and provision for encouraging, in a cultural and artistic setting, social contacts among staff and students.

The spirit and purpose of the laboratories are typified by the three marble panels which are set into the limestone walls just above the main entrance to the laboratories. To the left, which is the chemistry side of the building, is a medallion taken from a block medal showing the head of the young scientist, Jacobus Henricus Van't Hoff, discoverer of the important principle of molecular asymmetry, which is represented on the medallion by two tetrahedra, one the reverse of the other. To the right, which is the physics side, is a medallion of Sir Isaac Newton with an inscription epitomizing his three laws of motion. Between these two panels is a third containing a Latin quotation from Vergil, which may be translated literally as follows: "Happy is he who has been able to learn the causes of things and has cast beneath his feet all fears and inexorable Fate and the roar of greedy Acheron."

GENERAL ARRANGEMENT OF THE LABORATORIES

On entering the building, which is about 300 feet long and five stories high including basement, the chemistry laboratories are found on the left, the physics laboratories on the right, and in the center of the building are found successively, going from basement up, the shops, switchboard, generator and battery rooms, main lecture room, directors' offices, class rooms, departmental library, reading room and social room. Connecting with the physics side of the building is the special new spectroscopy laboratory of unique design for convenience, freedom from vibration and temperature control. This spectroscopy laboratory, which is now in use, is to be described separately in another article.



BASEMENT FLOOR PLAN

SCALE IN FEET

On the chemistry side, the basement and the first and second floors are assigned to physical chemistry, the third and part of the fourth floors to organic chemistry, and the remainder of the fourth floor to inorganic chemistry.

On the physics side, the basement is assigned to spectroscopy, supplementing the work in the main spectroscopy laboratory. The first and second floors are assigned to research in electronics and gaseous conduction. The third floor, which contains also the library, reading room and social room, is divided into a series of large and small offices for research in theoretical problems. The fourth floor is planned for work in x-rays, dielectric and other properties of matter, and contains a room with suitable communication through the roof for optical testing and work with the spectroheliograph which has been presented by an alumnus, Dr. George Ellery Hale, honorary director of the Mount Wilson Observatory.

The building connects at its two ends with other units of the main educational plant of the Institute and is in close proximity to the departments of electrical engineering and mining and metallurgy on the physics side, and to the departments of mathematics and chemical engineering on the chemistry side, and at the same time is closely adjacent to the regions in which the undergraduate instruction in physics and chemistry is carried on.

Laboratory Services and Special Features

Entrance Lobby and Corridors: The building is entered through carved teak doors into a large lobby whose walls are covered with Italian travertine. To the right and left are to be placed semi-permanent exhibits relating to physics and chemistry, and statues of two prominent scientists will flank the few steps rising from the entrance lobby to the main corridor. This corridor, like those on the other floors, is divided into three sections by fire doors which may be closed in emergency. The central section on the first floor is also finished in Italian travertine and has a false ceiling which conceals the overhead piping. In the other parts of the corridors the overhead piping is exposed but is so high as not to be objectionable.

Lecture Hall: Facing the entrance lobby is the main lecture room, with 195 seats which are raised, stepping up toward the back of the room in such a way as to provide space for an ample coat room beneath the rear seats and platform. The room is finished in travertine dado at the lower level, with California stucco above, and the ceiling is acoustically treated. In the rear is a completely equipped projection room for a double sound motion-picture installation and a stereopticon with automatic slide control, operated from the lecture table. Blackboards extend clear across the front wall with a sliding central section which is electrically operated. Above the blackboards are a loud-speaker and large multirange voltmeters and ammeters. Beneath the central blackboard is a very complete switchboard furnishing a great variety of electrical services to the lecture table, the electrical meters and the projection room.

The main lecture table is by far the most expensive and complicated piece of furniture in the building. About fifteen feet long, it has a sink at each end with gas, distilled water, compressed air, cold water, and steam outlets. From this table and the panel under the blackboard run controls for the automatic window shades, phone, signal and operating wires to the picture booth, lights and dimmer control, demonstration electric meters, timer, and sets of rheostats for regulating currents through the entire range up to 2,250 amperes. All electrical service available anywhere in the building is wired to the lecture table.

This unusually complete lecture room equipment has been designed with the assistance of Professor P. Scherrer, of the University of Zurich, who is internationally noted for the excellence of his lecture demonstrations and equipment.

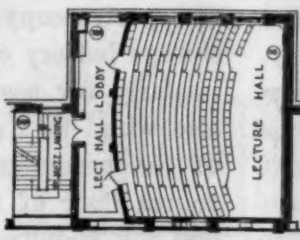
Shops: Realizing that the limitations of accomplishment in experimental research are often set by limitations of shop facilities, no effort has been spared to make the equipment and arrangement of the shops as nearly ideal as possible. The physics glass blowers' shop is located on the second floor, adjacent to the research stock room and close to one of the elevators. The remaining shops are located in the basement.

The main machine shops are located directly below the lecture hall. The chemistry shop occupies the left and the physics shop the right-hand side of this space, and the two are divided by an open iron grill. This separation into two shops is made in order to fix the respective responsibilities of the mechanicians attached to the two departments, but unnecessary expense due to duplication of equipment is avoided by the close communication between the two shops which enables machine tools of a type which are needed only occasionally to be shared by the two groups of workmen. The physics shop also extends into the adjacent rooms and includes an instrument maker's shop provided with small tools of extreme precision. Across the hall is a staff shop, an optical shop and a "tin and wood shop," which really means a shop for miscellaneous work of a type which is undesirable in the main shops. Similarly, on the chemistry side is a staff shop, carpenter shop and glass blowing room, together with a room for storage of shop materials.

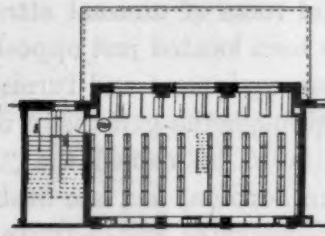
A very interesting feature of these shops is the provision which has been made to prevent the generation of vibrations and their transmission throughout the building. All of the smaller machine tools are mounted upon anti-vibration bases of the most approved type. For the larger machine tools, notably the large miller, shaper and grinder, a new protection against vibration has been installed with the assistance of Dr. Gerke, of the U. S. Rubber Company. Under these machines a pit of a depth of about two feet was left in the 3½ ft. reenforced concrete mat which underlies the entire building. On the bottom of this pit is laid a one-inch layer of the finest quality of sponge rubber of such a type as to be compressed to about nine-tenths of its original thickness under the weight which is to be loaded on it. This rubber is covered with a waterproof layer of transite board, on which is then put a solid reenforced concrete block, rising to the level of the surrounding floor. The sides of this block are separated from the surrounding floor by a similar layer of sponge rubber. The machine tool is then mounted on this sixty-ton concrete block with the aid of the ordinary anti-vibration protection. Thus the machine and its concrete base float on the sponge rubber. The theory of this installation is as follows: The mass of the machine tool and the elastic properties of the anti-vibration base, by which it is attached to the concrete, form such a combination as to transmit only a certain natural frequency of vibration into the block. The combination of the mass of the block and the elastic properties of the rubber on which it floats are such as to give this system a natural frequency about ten times smaller than that which is being fed into the concrete block. The system therefore acts as a double by-pass which effectually prevents the transmission of any vibrations to the floor of the building. Each of the three most important heavy machine tools is mounted in this way.

Offices: The offices of the director of the chemical laboratory and the two directors of the physics laboratory are located on either side of the entrance lobby, and every attempt has been made to make them attractive as well as convenient in order that they may promote the feeling that the pursuit of science has its cultural and human aspects as well as those aspects of efficiency and accomplishment which are the chief impressions gained from the shops and laboratories.

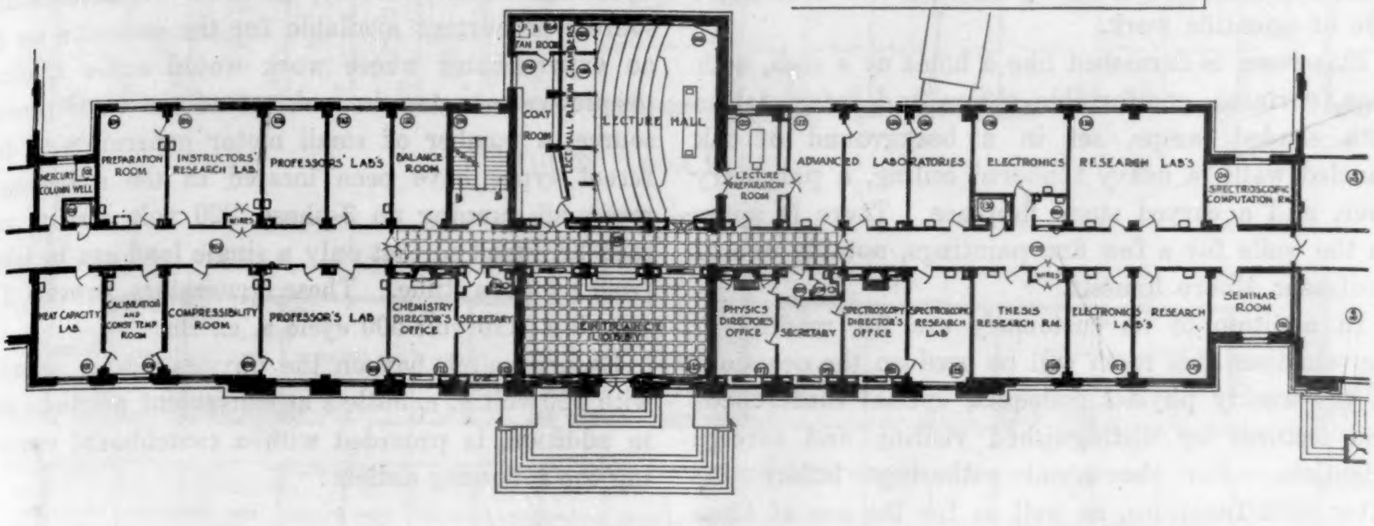
Through the generosity of Mrs. F. Jewett Moore, who has provided a fund for making the study of chemistry and its surroundings more interesting and attractive, the office of the director of chemistry has been given special architectural treatment. The walls of this office are paneled ten feet high in oak, with a rough textured tinted plaster above. The ceiling is arched and paneled in the English manner with raised mouldings. The large window is broken up with moulded mullions and transoms into small units set with leaded glass containing Lallique plaques. Opposite the window is a fireplace trimmed with limestone, and over it is the inscription: "Felix qui potuit



LECTURE HALL MEZZANINE PLAN



BOOK STACK MEZZANINE PLAN



FIRST FLOOR PLAN

SCALE IN FEET

rerum cognoscere causas." Above the mantel there is space for a painting, and on either side there are built-in bookcases. The floor is of oak, laid in parquetry design. The complete furnishings of the room are being given the attention and thought required to secure in this room, through its harmonious blend of line, color and arrangements, an atmosphere suggestive of the high aims and purposes to which the new home for science is dedicated.

On one side of the director's office is the departmental secretary's office, while on the other side is the director's laboratory.

The physics offices of administration are more simple, yet comfortable, dignified and interesting in design. They are finished in California stucco of a warm color, with raised wood mouldings forming large panels. The cornice and chair rail are of wood, painted to match the buff walls. Each room has a fireplace at the end opposite the window, and the fireplace is flanked on both sides with built-in bookcases. The floors are of wood, and the ceilings are acoustically treated with acousticelotex.

The remaining offices have the ordinary inside finish of the rest of the building. Of particular interest is the group of offices adjoining the departmental library, reading room and social room on the third floor. On the front of the building are larger offices, each provided with a built-in blackboard so that they can be used on occasion by students for conferences and seminars, while to the rear of the building are a group of small offices for graduate students and research fellows who are working on theoretical problems.

On the chemistry side of the building are several professors' offices with their special laboratories adjoining, including especially one such suite especially designed for guest professors.

Physics-Chemistry-Mathematics Departmental Library: Immediately above the lecture hall is a book stack-room with floors on two levels, one being the level of the third floor and the other the level of a mezzanine floor below. These two floors of stacks can accommodate approximately 40,000 volumes. The two floors of this stack-room also contain a series of cubicles beside the windows, in which are seats and desks where men who desire continual convenient access to the stacks may carry on their work.

Opening into the book stacks is a large reading room with a rubber tile floor, tinted green stucco walls, an acoustically treated ceiling, comfortable furniture, and reference books and current periodicals conveniently located around the walls. The effort has been made to make this room an attractive working space for the study of research problems. Beside the entrance to the reading room is the library file and the desk of the branch librarian, who is in charge of this library and is at the same time a member of the staff of the central library of the Institute. This branch library is designed essentially as a "working" library rather than as a depository, and in it will be found only such books, periodicals and treatises as are of importance in connection with research work.

Forris Jewett Moore Room: Still further to promote cooperation and intercourse among the men who will be working on their special problems in this

building, a social room of unusual attractiveness and convenience has been located just opposite the library. This room, whose equipment and furnishing has been made possible through the generosity of Mrs. Forris Jewett Moore, is to be named the "Forris Jewett Moore Room" in honor of her late husband, who was professor of chemistry at the Institute from 1902 to 1925, and who was unusually interested in the human side of scientific work.

This room is furnished like a home or a club, with rugs, curtains, comfortable chairs and sofas, tables with shaded lamps, set in a background of oak paneled walls, a heavy timbered ceiling, a parquetry floor, and a carved stone fireplace. There is space on the walls for a few fine paintings, notably one of Professor Moore himself.

In addition to its customary use for reading or conversation, this room will be used on the occasions of the weekly physics colloquia, special conferences, and lectures by distinguished visiting and foreign scientists. For the social gatherings before and after such functions, as well as for the use of those who are accustomed to enjoy a few minutes away from their work in the afternoon for the purpose of recreation, thought or intercourse, a fully equipped kitchenette is provided, adjoining the social room, in which tea or other refreshments may be prepared.

Special Rooms: In addition to the rooms mentioned above, the following are suggestive of some of the facilities of the laboratory. There is a mercury column well extending the height of the building. There are two passenger elevators, one on each side of the building. Freight elevators are available in the buildings, connecting with each end of these laboratories. There is a constant temperature room for the calibration of instruments, and another group of large constant temperature rooms is provided in the basement. There are several photographic dark rooms. One room is being particularly equipped with mechanical aids for computation.

Electrical and other Services: The electrical current used in the laboratories is derived principally from five sources, all fed ultimately from the power plant of the Institute. The large transformer and motor generator sets are located in closely adjacent buildings in order to reduce vibration hazard. In the room below the steps of the main entrance are two storage batteries. One is of 240 volts subdivided into two 120 volt units, one of which acts as a ballast across the 120 volt motor generator set. The other battery is also 120 volts and is subdivided into ten 12 volt units which can be connected in any combination of series or parallel arrangement by making suitable connections on a mercury pool-in-marble switchboard. Beside the opening of the passage into the spectroscopy laboratory is still another 120 volt storage battery of very large capacity, designed particularly for use in the spectroscopy laboratory but also wired to a series of outlets on the physics side of the basement of the main laboratory. On the fourth floor of the physics side is installed a 100,000 volt stabilized direct current generator for x-ray and other uses. Finally, in order to have certain sources of current available for the exclusive use of an experimenter whose work would suffer if other people were to tap in and out of the same current source, a number of small motor generators of different types have been located in the switchboard room, all running on 3-phase, 220 volt current, and each arranged so that only a single load can be taken from it at a time. These generators provide 110 volt d. c., 110 volt 500 cycle a. c., etc.

Each research bay on the physics side is provided with 120 volt a. c. outlets at convenient positions and, in addition, is provided with a switchboard containing the following outlets:

240 volt, 3-phase a. c.
240/120 volt, 1 phase, 60 cycle a. c.
240/120 volt d. c.
700/350 volt d. c.
2 60-ampere lines running from the central distributing switchboard.
8 signal lines running throughout the laboratory.

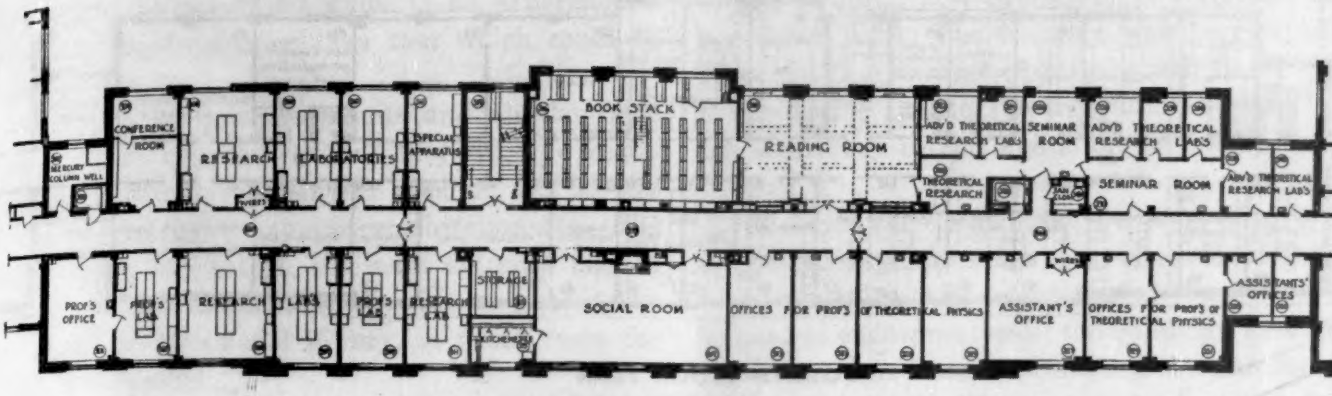
On the chemistry side each research bay is similarly equipped except for omission of the 700/350 volt line.

The main electrical control and distributing switchboard is located in the basement of the building below the entrance lobby. A separate switchboard is placed beside the special storage battery for the spectroscopy laboratory and intermediate distributing and fuse boards are located in the hallway on each floor, near the center of the physics and of the chemistry sides of the building. Altogether there are 1,100 lighting outlets, 1,400 experimental outlets and about 70 miles of wiring in the building.

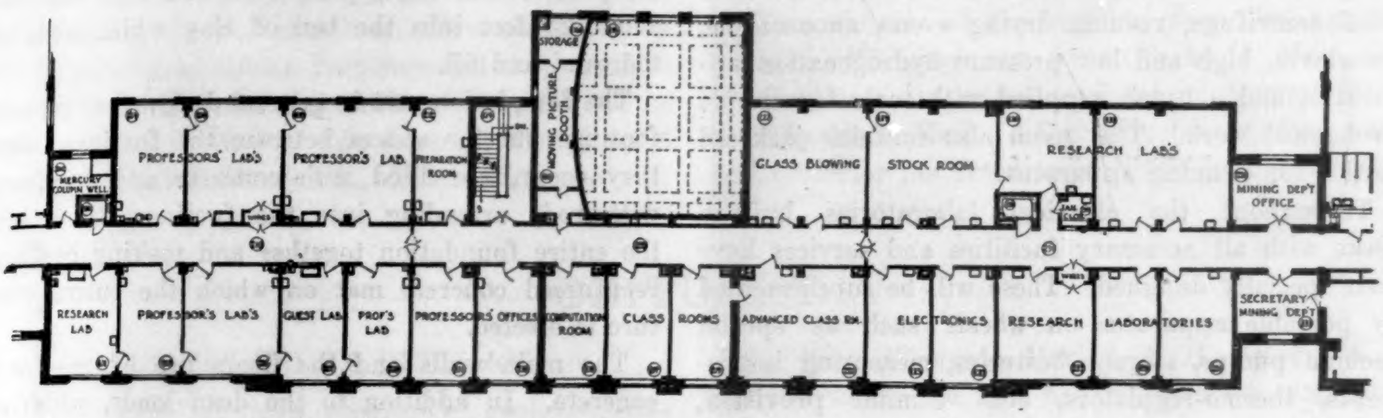
Hot and cold water, gas and compressed air are piped to all research bays, and distilled water is piped to all bays in the chemistry laboratories and to a few selected points on the physics side.

The ventilating hoods on the chemistry side are provided with individual forced draught for each room, the discharge vent being located on the roof.

Forced draught ventilation is provided in the lecture, class, library, and seminar rooms, but not in the individual offices or research rooms, which will depend upon the adjustment of casement windows and of steam radiators for temperature and ventilation control.



THIRD FLOOR PLAN



SECOND FLOOR PLAN

SCALE IN FEET

Special Equipment of the Chemical Laboratories: Except for the work in spectroscopy, which is separately provided for in the new spectroscopy laboratory, the research rooms on the physics side require no further description, since the facilities already described are adequate for the installation of all types of physical research which are now contemplated, and for which appropriate apparatus will be installed as needed. On the chemical side of the building, however, there are certain additional features of a permanent nature which deserve special mention.

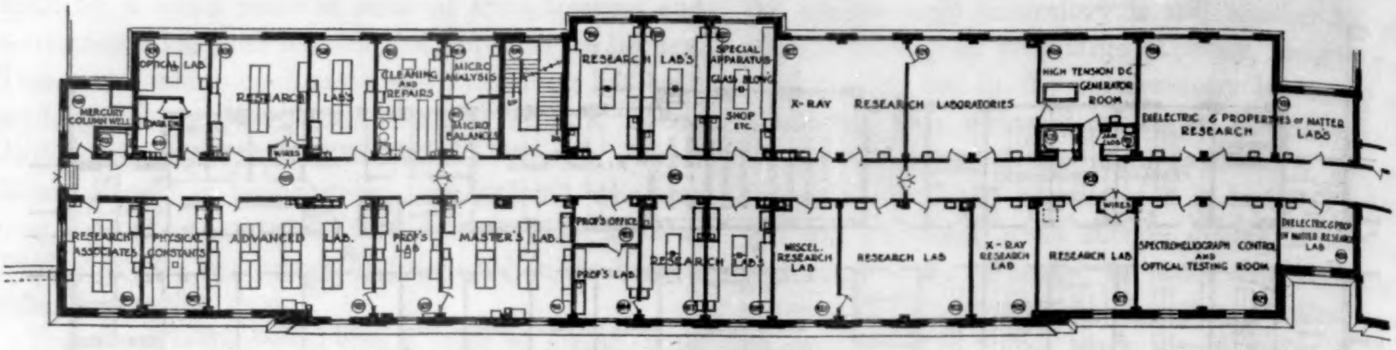
In the laboratory of physical chemistry there will be installed a 70 foot, jacketed, mercury column, provided with a special well so that precise measurements involving the application of high pressure may be carried to pressures of several thousand atmospheres.

A special constant temperature room will contain rather elaborate equipment for gas thermometry and platinum resistance thermometer standards, and will be accessible for calibration at all available temperatures of the various types of secondary thermometers used throughout the laboratory. A similar room will contain very complete equipment for the measurement of volumes and the temperature dilation of materials at atmospheric pressure. In the same room will be installed apparatus for measuring the two principal elastic constants of materials over long ranges of temperature. This same room will also contain standard cells and calibrated standards of resistance and resistance bridges to serve as standards for the measurements of energy, which are usually carried out by electrical means. All calibration and wiring diagrams will be framed and hung on the walls beside the apparatus.

A special balance room, which will be maintained at substantially constant temperature, will contain complete standard equipment for weighing masses from 5 kilograms to 5 micrograms. The standard and calibrated weights for these ranges are to be kept in cases in this room.

Various rooms devoted to investigations of gaseous and other equilibria, of van der Waals' forces, or molecular attractive and repulsive forces, of problems in photochemistry, and measurements pertaining to heat capacity, are all being especially equipped and are located so as to secure a maximum degree of coordination between these related fields of investigation.

In the space allotted to organic chemistry on the two upper floors, there is one room specially designed for optical work with spectrographs, polariscopes, refractometers, and an adjacent dark room. A second room is being equipped for the determination of physical properties, molecular weights, electrical conductivity, and volumetric analysis. A third room is being devoted to micro and semi-micro methods of



FOURTH FLOOR PLAN

SCALE IN FEET

analysis, and a fourth room contains a large electrical centrifuge, vacuum drying ovens, an ozonizer, autoclaves, high and low pressure hydrogenation apparatus, and a bench supplied with tools for simple mechanical work. This room also contains jacketed kettles for cleaning apparatus.

Throughout the chemical laboratories built-in desks with all necessary facilities and services have been specially designed. These will be supplemented by portable apparatus on wheels such as special vacuum pumps, storage batteries, measuring instruments, thermo-regulators, etc. Similar provision, primarily for the physics group, is being made for portable services such as high-frequency induction heaters, specially isolated portable batteries, and similar apparatus which may be mounted on rubber-wheeled trucks and taken from place to place as desired.

Special Architectural and Structural Features: Any modern laboratory must be rigid in construction, flexible and convenient in arrangements. In order to serve its purpose in an educational institution it should also be attractive and contain those intangible features which lead to better understanding of the ideals and the aims as well as the methods and particular difficulties of the various branches of the physical sciences.

In appearance this building carries out the same design as the main educational group at Massachusetts Institute of Technology. The entire front is of Indiana limestone with a granite grass course. The large windows are a combination of casements and top hung vents surrounded by fixed panes.

Since the subsoil at this location consists of fill and organic silt averaging 12 feet in thickness at the northerly end and 21 feet in thickness at the southerly end, all resting upon glacial drift of sand, and since there are traffic disturbances in the neighborhood, great pains were taken in the design and construction in order to insure a high degree of rigidity in the structure. About 2,800 piles support the building. At the northerly end these are stopped in a bed of compact gray sand, while at the southern end where the sand layer is too thin to afford support to the piles, much longer piles were used and embedded about 25 feet into the bed of clay which underlies the sand and fill.

The foundations are in general designed as separate footings but the spaces between the footings, where they occur, are filled with concrete and reenforced with rods extending into the footings, thus tieing the entire foundation together and making one huge reenforced concrete mat on which the entire structure is erected.

The main walls and the floors are of reenforced concrete. In addition to the dead loads, which are exceptionally heavy, the live loads are as follows:

Roof	50 lbs. per sq. ft.
3rd and 4th floors	75 " " " "
2nd floor	125 " " " "
1st floor	150 " " " "

All columns, girders, floor beams, longitudinal corridor beams, and floor slabs are made larger and stiffer than usual in order to increase rigidity.

Except for the solid concrete transverse partitions, which were introduced for additional stiffening, the remaining transverse partitions consist of gypsum blocks with plaster finish. These partitions can be readily drilled and can be readily knocked out or rebuilt if future uses of the building should require a change in the present location of partition walls.

The floors are of terrazzo, the ceilings of exposed concrete, and the finish is of stained birch. The door frames and window frames are of pressed metal. A pipe sleeve is provided in the floor of every bay and in the partition wall between every two adjoining rooms in order to permit the temporary drawing of wires or pipes between adjacent rooms on the same floor, or one above the other, thus facilitating types of intercommunication which have not been provided in the regular equipment of the buildings.

All horizontal piping and all fittings on the chemistry side of the building are of chemical resisting Duriron. All other piping is cast iron, except for the distilled water, which is carried in block tin pipes. Sprinklers are installed in the corridors only, since the building is entirely fireproof and the damage

which might be caused by water in an experimental room is probably greater than that which could be caused by fire.

All piping, all power conduits and all the fume ducts are run exposed so that they may be easily added to, repaired, or changed. Ceiling heights are such as to render this exposure unobjectionable. The exceptions to this are in the main entrance hall in the center of the building and in the permanent lecture rooms or offices and library, in which cases the piping is concealed.

It is expected that the final cost of the laboratories will be approximately $1,146,000, including architects' and engineers' fees and an allowance of $125,000 for laboratory tables, furniture and shop machinery. If the cubage of the building is figured to the bottom of the mat over the tops of the piles, it amounts to 1,367,000 cu. ft., from which the cost of the building and equipment is estimated at $.83 per cubic foot. The building will be completed in May and the research apparatus will be moved into it during the summer, so that it is expected to have the laboratory in full operation beginning with next October.

The funds for the building were provided in a gift by Mr. George Eastman for educational buildings when needed, with the proviso that these funds could be used as endowment until the buildings were needed. Mr. Lammot du Pont has contributed an amount equal to the interest on the cost of the building for two years, in order to expedite its construction.

The architects of the building were Coolidge and Carlson. The engineers were Charles T. Main, Inc. The building committee consisted of Everett Morss and Charles T. Main. All construction work was carried on under the direction of Stone and Webster.

OBITUARY

ALBERT PERRY BRIGHAM

ALBERT PERRY BRIGHAM, geographer, geologist, educator and humanist, died in Washington, D. C., on March 31, in the seventy-seventh year of his age. Born in Perry, New York, on June 12, 1855, and surrounded in his youth by the rich fossiliferous horizons of the Genesee Valley, what was more natural than that his alert and inquiring mind should be early aroused to an interest in geology. Later, having the good fortune to attend a series of lectures in geology in his college days, given by a man with keen insight into nature and with a rich philosophy, Brigham's interest in the subject was deepened.

But it was many years before he could yield to the urge and enter into training for what proved to be his life work. After graduating as valedictorian of his class and with high honors in classics, he trained to be a minister, and for nearly ten years was a successful pastor in Stillwater and Utica, New York. That pastoral duties did not check his following his avocation is indicated by the fact that his first paper, entitled "The Geology of Oneida County," was published in 1888, three years before he resigned his pastorate and entered the Harvard Graduate School.

This turning point in his career was the result of his experience in a summer vacation in 1889, when he attended the six weeks' Harvard field course in geology. Here he came under the influence of those master teachers of their day, Nathaniel Southgate Shaler and William Morris Davis, who, with Robert Tracy Jackson, the paleontologist, were later his teachers in his year at Harvard. Here, in a group which included Tarr, Westgate, Marbut, A. H. Brooks, Ward and the writer, he first had his interest aroused in physiography of the lands and for several years Brigham's publications and public addresses were largely devoted to physiographic topics.

Returning to Colgate University, his alma mater, as professor of geology in 1892 and until his retirement in 1925, he taught many generations of youth geology and geography, and, what is more, so gained their confidence and affection as to be a vital influence in their lives. With the eagerness of youth, which abided through life, Brigham at once began to be of the widest service to his science. A clear thinker, vigorous and fearless of speech, with a personality that won the confidence of his hearers, Brigham soon became in demand as a speaker to audiences of teachers and laymen. A regular attendant and contributor at professional meetings, his reputation grew apace, and when the Association of American Geographers was formed in 1904 it was just as natural to turn to Brigham for the secretaryship as it was to make the founder, Professor Davis, the first president.

For nine years Brigham guided the destinies of this little group of geographers who were bound together only loosely by any common interests. He contributed regularly to the programs a series of papers which indicate the gradual transfer of his major interest from physiography to economic geography and later to the human side of the subject. He also found time to take an active part in the work of the New York State Science Teachers Association, serving one year as president, and for eleven years was chief examiner on geography for the College Entrance Ex-

amination Board. He was also examiner for the New York State Education Department for several years.

These many duties did not interfere with his productive work, as is indicated by the fact that more than eighty major titles in science and education have come from his pen in the last forty-four years. These include articles on geology, geography and education and books for young and old in a wide field. High-school texts in geology, physical geography, with G. K. Gilbert, commercial geography and a series of elementary school texts, with C. T. McFarlane, were supplemented by books in the relation of geography and history and culminated in his volume on the United States based on a series of lectures at London.

For fourteen years Brigham taught in summer schools in this country and for five in England. He attended and took part in several geographical congresses and visited Europe many times. His acquaintance was wide and his many and varied contributions to all phases of geography made him one of the best known geographers of the world.

Honors came rapidly to him for many years. He served one year as president of the Association of American Geographers immediately after his retirement as secretary. He was also president of the National Council of Geography Teachers. His alma mater, as well as Syracuse University and Franklin College, conferred honorary degrees upon him. But the compliment that he prized most was the number of the Annals of the Association of American Geographers that was issued on his seventy-fifth birthday. Here his colleagues and friends paid measured tribute to Brigham—the man, the geologist, the physiographer, the human geographer, the educator and the geographer-envoy from America to Europe. In these several papers, accompanied by a bibliography, is a summary—an appraisement of Brigham's life work to 1930, written with the restraint necessary in writing to the living. Between the lines one can see the affectionate regard and the honor that each writer, speaking for his colleagues, felt for Brigham. This volume was a deserved and yet inadequate tribute that may be summarized in the recent words of one of the younger men who said, "He was a Grand Man in the earth sciences."

His spirit will carry on, and like that of any great teacher or leader, his work will bear results for many generations yet to come. He honored the sciences to which he devoted the major part of his life, and the honors his colleagues naturally bestowed upon him were truly earned.

RICHARD ELWOOD DODGE

SCIENTIFIC EVENTS

SYMPOSIA AT THE SYRACUSE MEETING OF THE AMERICAN ASSOCIATION

PROGRAM plans for the association's approaching meeting at Syracuse, New York, June 20 to 25, 1932, are rapidly nearing completion. It is expected that the final program will include addresses on subjects of general interest by outstanding scientists in the fields of mathematics, physics, engineering, chemistry, botany, medicine, psychology and education. The association's sections are arranging a scientific session devoted to symposia on timely subjects and also a number of field trips. Program features include the following: Mathematics—invited addresses by four mathematicians of national reputation and a symposium on "The Teaching of Mathematics" (jointly with the Section of Education) with an address by Dr. E. R. Hedrick; Physics—symposium on "The Nature of Light," a joint session with chemists and biologists for a symposium and a general address by Dr. W. F. G. Swann on "Cosmic Rays"; Chemistry—symposium with biologists and physicists on "The Effect of X-rays on Biological Life" and a regional meeting of the American Chemical Society; Geology and Geography—symposia on (1) "Paleozoic Stratigraphy of New York," (2) "Physiography near Syracuse including Glacial Problems," (3) joint session with engineering section on "Aerial Photographic Surveying and Mapping," and conducted geological excursions; Zoology—symposium at joint sessions with chemists and physicists on "The Effect of X-rays on Biological Life" and a series of conducted field trips and a meeting of the Ecological Society of America; Botany—meetings of the Botanical Society of America and other societies and a series of field trips; Anthropology—symposium on Far Eastern Problems; Psychology—symposia on (1) "Industrial Psychology" (jointly with Engineering Section); (2) "Social Statistics" (jointly with Economics, Sociology and Statistics Section); (3) "Mental Hygiene" and a two-day meeting of the Upper New York psychologists; Economics, sociology and statistics—symposia on (1) "Demand and Supply," (2) "Money and Interest" and (3) "Social Statistics," and meetings of the Econometric Society and the American Statistical Association; Engineering—(1) Symposia on "Aerial Photographic Surveying and Mapping," (2) "Industrial Engineering" and (3) "Industrial Psychology" (jointly with the Section of Psychology) and a general address by Dr. J. O. Perrine on "Television"; Medical sciences—several symposia on subjects to be announced later and meetings of the Society for Experimental

Biology and Medicine (Western New York Branch), The American Roentgen Ray Society, the Society of American Bacteriologists (Central New York Branch), Onondaga County Medical Society, and the Syracuse Academy of Medicine; Agriculture—series of symposia on "Land Use" and a symposium on "The Future of the Farmer, Peasant or What?"; a meeting of Northeastern Section of American Society of Agronomy at Geneva and Ithaca; Education—a symposium on (1) "The Teaching of Mathematics" and (2) "Educational Psychology" and a general address by Professor E. L. Thorndike. In addition, several sections of the association will hold sessions for the reading of contributed papers.

CHARLES F. ROOS,
Permanent Secretary

NATURE SANCTUARIES

THE Ecological Society of America has maintained a committee concerned with reservation of natural areas for research purposes since 1917. This committee called a conference on Nature Sanctuaries at New Orleans on December 30, 1931, including the following representatives of societies and government bureaus:

Dr. Francis Ramaley, *chairman,* Ecological Society; Dr. W. R. Chapline, U. S Forest Service; Dr. S. B. Locke, Izaak Walton League; Dr. H. C. Bryant, National Park Service; Dr. Walter P. Taylor, U. S. Biological Survey; Dr. T. Gilbert Pearson, American Ornithological Union; Dr. A. R. Cahn, Ecological Society; Dr. Henry B. Ward, National Parks Association; Mr. Paul L. Errington, Game Survey, conducted for the Sporting Arms and Ammunition Manufacturers Institute; Dr. B. C. Tharp, Ecological Society; Dr. W. S. Cooper, Ecological Society, and Dr. V. E. Shelford, National Research Council.

The representatives at the conference stated the general plans and procedure followed in the reservation by federal agencies of the few existing nature sanctuaries, called "natural areas," "research reserves," etc. They also outlined the ideal plans for nature sanctuaries, conceived in the various organizations representing different biological interests.

After the conference the following report was adopted by the representatives through the mail:

The participants were agreed that it is desirable and important to set aside, as nature sanctuaries or nature reserves, areas of natural vegetation containing as nearly as possible all the animal species known to have occurred in the areas within historical times.

Nature sanctuaries should be surrounded by very slightly modified areas devoted to experiments, recreation or game culture, etc.

It was the consensus of opinion of those in attendance that these areas should be left alone without management and that only in the case of an emergency that might arise should control measures be undertaken and then only after most careful consideration and determination as to their practical necessity.

V. E. SHELFORD, *Chairman*
Committee for the Study of Plant and Animal Communities, Ecological Society of America

COMMITTEE ON UNEMPLOYMENT AND RELIEF FOR CHEMISTS AND CHEMICAL ENGINEERS

DR. FRANK G. BREYER, executive chairman of the Committee on Unemployment and Relief for Chemists and Chemical Engineers, has addressed to members of the twelve sponsoring societies the following letter:

More than one hundred members of our profession in the Metropolitan District are in want. Their families are approaching despair. Fifteen hundred more are out of employment. Some have been unemployed for over a year.

Professional fellowship and human sympathy demand that the more fortunate of us contribute to the immediate relief of the destitute in our profession. Public relief funds administered by the Gibson and Bliss Committees are running low. They are inadequate to meet the general situation and can no longer be counted upon to take care even of the most desperate cases.

This committee has been organized by the local sections of all the important national chemical and chemical engineering societies. Administrative costs will be paid from funds given specially for this purpose. Your contribution will be applied directly, immediately and sensibly to the relief of chemists and chemical engineers.

We feel the best temporary solution is to finance the work of the Committee on Unemployment and Relief for the period April 25 to July 1. $15,000 is required. An average of $5.00 per month for two months from 1,250 men will give $12,500. We can get $2,500 from other sources. Won't you send by return mail a contribution? Less than $5.00 if you can't afford it. More than $5.00 if you are able. To be followed by an equal sum one month later.

The need is immediate and urgent! Unless we who are more fortunate respond generously many members of our profession face real want, demoralization and tragedy.

Checks should be made payable to R. T. Baldwin, treasurer, and be sent to 300 Madison Avenue, Room 1004, New York City.

AWARD OF THE WILLARD GIBBS MEDAL

DR. EDWARD CURTIS FRANKLIN, professor emeritus of organic chemistry at Stanford University, has been awarded the Willard Gibbs Medal for 1932 by the

Chicago Section of the American Chemical Society. The medal will be presented to Dr. Franklin before a national gathering in Chicago on May 20.

"Dr. Franklin's work on liquid ammonia solutions," the citation reads, "opened up an entirely new field, and also modified profoundly our views on aqueous solutions. He has made a life-long study, characterized by insight, thoroughness and experimental skill, of reactions in liquid ammonia. All trained chemists, both organic and inorganic, are aware of the profound effect of Franklin's work upon modern concepts of the relation between the solvent and the chemistry of the solute. The well-known experimental and theoretical development constituting practically a lifetime contribution has received recognition of the American Chemical Society through the fact that Dr. Franklin was president of our society at one time."

The Gibbs Medal, founded by William A. Converse, was first awarded in 1911 to Svante Arrhenius, of Sweden. It is named for Josiah Willard Gibbs, professor of mathematical physics at Yale from 1871 until 1903, who, although not primarily a chemist, did much to advance the science of physical chemistry.

Previous medallists in addition to Svante Arrhenius include Madame Curie, of France; Sir James C. Irvine, of Scotland, and the following Americans: T. W. Richards, L. H. Baekeland, Ira Remsen, Arthur A. Noyes, Willis R. Whitney, E. W. Morley, W. M. Burton, W. A. Noyes, F. G. Cottrell, Julius Stieglitz, G. N. Lewis, M. Gomberg, J. J. Abel, W. D. Harkins, Claude S. Hudson, Irving Langmuir and Phoebus A. Levene.

Members of this year's jury of award are: B. S. Hopkins, W. Lee Lewis, S. C. Lind, Julius Stieglitz, W. D. Bancroft, G. Borrowman, Otto Folin, F. C. Whitmore, W. L. Evans, J. H. Hildebrand, L. V. Redman and H. Steenbock.

ELECTIONS OF THE NATIONAL ACADEMY OF SCIENCES

At the annual meeting of the National Academy of Sciences held in Washington on April 27, the fifteen new members permitted by the rules were elected as follows: Raymond T. Birge, physicist, University of California; Edwin G. Boring, psychologist, Harvard University; Samuel R. Detwiler, anatomist, Columbia University; Walter A. Jacobs, chemotherapist, Rockefeller Institute for Medical Research; Douglas W. Johnson, geologist, Columbia University; Louis O. Kunkel, plant pathologist, Boyce Thompson Institute, Yonkers, New York; Karl Landsteiner, pathologist, Rockefeller Institute for Medical Research; Walter C. Mendenhall, geologist, U. S. Geological Survey; (Harold) Marston Morse, mathematician, Harvard University; Floyd K. Richtmyer, physicist, Cornell University; John C. Slater, physicist, Massachusetts Institute of Technology; John R. Swanton, anthropologist, Bureau of American Ethnology; Robert J. Trumpler, astronomer, Lick Observatory; Edward W. Washburn, chemist, Bureau of Standards; John B. Whitehead, electrical engineer, the Johns Hopkins University.

Four foreign associates of the academy, who are limited to fifty, were elected. They are: Karl E. von Goebel, botanist, Munich; Fritz Haber, chemist, Berlin; Marchese Marconi, engineer, Italy, and Heinrich Wieland, chemist, Munich.

Arthur Keith, the U. S. Geological Survey, was elected treasurer to succeed President Joseph S. Ames, of the Johns Hopkins University. Professor Ross G. Harrison, Yale University, and Professor Henry Norris Russell, Princeton University, were elected members of the council to succeed Professor Edwin G. Conklin, Princeton University, and Dr. Harlow Shapley, the Harvard Observatory. Officers of the academy, apart from the treasurer, who were elected last year for a four-year term are Dr. W. W. Campbell, University of California and the Lick Observatory, *president;* Dr. David White, U. S. Geological Survey, *vice-president;* Dr. Fred E. Wright, Geophysical Laboratory of the Carnegie Institution, *home secretary;* Dr. R. A. Millikan, the California Institute of Technology, *foreign secretary.* Members of the council continuing in office are: President Karl T. Compton, the Massachusetts Institute of Technology; Dr. W. B. Cannon, Harvard Medical School; Dr. J. McKeen Cattell, New York, and Dr. Roger Adams, University of Illinois.

Dr. W. H. Howell, who retired this year from the directorship of the School of Hygiene and Public Health of the Johns Hopkins University, has been elected chairman of the National Research Council, to succeed Dr. George K. Burgess, director of the Bureau of Standards. A successor to Dr. Vernon Kellogg as permanent secretary of the council has not been elected.

At the dinner of the academy on April 26, the Mary Clark Thompson Medal was presented to Dr. David White, U. S. Geological Survey, the presentation address being made by Professor William B. Scott, of Princeton University. The Public Welfare Medal, awarded a year ago to Dr. Wyckliffe Rose, formerly general director of the International Health Board and president of the General Education Board, who has since died, was received by his son, H. Wyckliffe Rose, the presentation address being made by Dr. Simon Flexner, the Rockefeller Institute for Medical Research.

SCIENTIFIC NOTES AND NEWS

The death is announced by cable of Dr. Max Rubner, the distinguished physiological chemist of the University of Berlin.

Dr. Robert A. Millikan, director of the Norman Bridge Laboratory of Physics and chairman of the council of the California Institute of Technology, who has been attending the annual meeting of the National Academy of Sciences of which he is foreign secretary, and Dr. Ray Lyman Wilbur, Secretary of the Interior, with leave of absence from the presidency of Stanford University where he was formerly professor of medicine and dean of the medical school, were the guests of President Hoover at his first week end of this year at the Rapidan camp.

Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, has returned to New York on the *Berengaria,* after a 27,000 mile trip on the motorship *Polaris.* He visited on this boat the South Sea Islands, Fiji Islands, Java, Sumatra, Saigon, Siam, Singapore, Ceylon and Cairo.

Dr. Werner Heisenberg, professor of theoretical physics at Leipzig, will take part in the fifth annual symposium in theoretical physics of the University of Michigan, to be held in connection with the summer session from June 27 to August 19.

Edward Goodrich Acheson, distinguished for his contributions to electrometallurgy and chemistry, especially in relation to graphite and carborundum, who was elected to membership in the American Philosophical Society on April 22, had died on July 6, 1931, at the age of seventy-five years.

The German Academy of Sciences in Halle at its recent meeting elected to membership Dr. Joseph Erlanger, professor of physiology in the Washington University (St. Louis) Medical School.

Franklin Medals, the highest honor conferred by the Franklin Institute of Philadelphia, have been awarded to Dr. Ambrose Swasey, of Cleveland, builder of telescopes and instruments of precision, and to Dr. Phillip Lenard, director of the radiological institute of the University of Heidelberg. The medals will be presented on May 18, but Dr. Lenard will be unable to attend.

Awards have been made by the Royal Geographical Society as follows: The Founder's Medal to Mr. H. G. Watkins, for his work in the Arctic Regions, especially as leader of the British Arctic Air Route Expedition. The Patron's Medal to the Duke of Spoleto, for his work in the Himalaya as leader of the Karakoram Expedition of 1929. The Victoria Medal to Professor A. P. Coleman, of Toronto, for his contributions to the geography and geology of Canada. The Murchison Grant to Dr. K. S. Sandford, secretary of the Commission of the International Geographical Union on Pliocene and Pleistocene terraces, for his personal work in that investigation during the past six years. The Back Grant to Mr. Hugh Clutterbuck, for his expedition to Akpatok Island. The Cuthbert Peek Grant to Miss Gertrude Caton-Thompson, for her investigations in the historical geography of Lake Moeris. The Gill Memorial to Dr. E. B. Worthington, for his studies of East African lakes.

The *Journal* of the American Medical Association reports that information has been received by the president of the British Ross Award Fund that sufficient funds have been received for the tribute to Sir Ronald Ross, begun last summer. It was planned to raise a fund of a million shillings for Sir Ronald, discoverer of the rôle of the mosquito in the transmission of malaria. About $500 was contributed by American physicians through the Ross Award Fund of America, of which Dr. Robert L. Pitfield, Philadelphia, was secretary.

At the ceremonies connected with the celebration of the seventy-fifth anniversary of the Chicago Academy of Sciences, the principal address was given on April 11, by Dr. William D. MacMillan, professor of astronomy at the University of Chicago. Officers of the academy have been elected as follows: *President,* Professor Henry C. Cowles, University of Chicago; *Vice-presidents,* Francis R. Dickinson, succeeding Dr. William H. Haas, resigned, and Dr. Edmund Andrews, and *Secretary,* Dr. Nathan S. Davis, III.

Dr. T. M. Simpson, head of the department of mathematics of the University of Florida, was recently elected president of the Southeastern Section of the Mathematical Association of America.

Dr. Oliver Justin Lee, for the past three years acting director of the Dearborn Observatory of Northwestern University, has been made director.

Dr. Augustus G. Pohlman, research professor of anatomy at St. Louis University School of Medicine, has been appointed dean of the School of Medicine at the University of South Dakota.

Jacob P. Den Hartog, since 1931 chief of the dynamics section of the research laboratory of the Westinghouse Electric and Manufacturing Company, has been appointed assistant professor of applied mechanics at Harvard University.

Dr. W. J. Miller, professor of geology and chairman of the department of the University of California at Los Angeles, delivered the annual faculty research

lecture on May 2. The lecture was on "Magmatic Intrusion."

The annual Hermann M. Biggs Memorial Lecture was delivered this year at the Academy of Medicine, New York City, on May 5 by Dr. Lawrason Brown of Saranac Lake. The subject was "Robert Koch and His Life Work."

M. Albert Policard, professor of histology in the University of Lyons, will deliver a Hanna Lecture at the Institute of Pathology of Western Reserve University on May 16, on "The Evolution of Histochemistry."

Dr. Stanhope Bayne-Jones, head of the department of bacteriology at the University of Rochester School of Medicine and Dentistry, gave the address at the annual Sigma Xi initiation dinner of the Rochester Chapter, on April 20. His subject was "Bacterial Variation and Changes in Bacteriology."

Dr. Harlan T. Stetson, director of the Perkins Observatory, Delaware, Ohio, lectured at Syracuse University on Friday evening, April 22, on "The Relation of Sunspots to Radio Reception." The lecture was sponsored by the local chapter of Sigma Xi.

Dr. Joseph Erlanger, professor of physiology at the Washington University (St. Louis) Medical School, delivered a lecture at the University of Michigan on April 26 on "Action Potentials of the Nerve."

Dr. Walter B. Cannon, professor of physiology at the Harvard University Medical School, recently gave the eighth Noble Wiley Jones lectures at the University of Oregon Medical School. The subjects of his addresses were: "The Fluid Matrix as a Means of Stabilizing the Organism," and "The Function of the Autonomic Nervous System in Controlling the Fluid Matrix."

Professor Ludwig Pick, professor of pathologic anatomy at the Friedrichshain Hospital, Berlin, spoke on April 27 on "The So-called Malacic Disorders of Bone" at the annual meeting of the Undergraduate Medical Association of the University of Pennsylvania, under the auspices of the Pathological Society of Philadelphia and the Rush Society of the University of Pennsylvania.

Sir Humphry Rolleston gave the Chadwick public lecture on April 8 in the hall of the Academy of Medicine, Paris, on "The Pioneers and Progress of Preventive Medicine." M. Meillère, president of the academy, presided.

Dr. Maurice C. Hall, chief of the zoological division of the Bureau of Animal Industry, U. S. Department of Agriculture, gave a series of three lectures from March 29 to April 1 at the School of Tropical Medicine, San Juan, Porto Rico. The lectures were as follows: "Principles and Theories of Anthelmintic Medication," "Specific Anthelmintic Medication" and "Parasitology in Its Relation to Other Sciences."

Dr. James W. Jobling, head of the department of pathology of the College of Physicians and Surgeons, Columbia University, attended the annual meeting of the special board of trustees of the School of Tropical Medicine, San Juan, Porto Rico.

The fourth of five awards of funds provided by the Rockefeller Foundation for a year's visit by an American university professor to the Keio Gijuku University of Tokyo, Japan, has been granted to Dr. Winterton C. Curtis, who has for thirty-one years been a member of the faculty of the University of Missouri. As a visiting professor Dr. Curtis will maintain an office in the Keio School of Medicine, in a building erected by the Rockefeller Foundation. He will give instruction in the School of Medicine and in addition will carry on research work.

Dr. Yandell Henderson, professor of applied physiology at Yale University, appeared in Washington on April 19 before a subcommittee of the Committee on Agriculture and Forestry of the Senate, headed by Senator McNary, to speak on a bill which he drew up for Senator Hiram Bingham which is designed to control poisonous substances and preparations which go into households. These substances include benzol, methyl alcohol, formaldehyde, sulphur dioxide, nicotine, etc., and failure to warn consumers of their dangerous properties has led to many fatal accidents. The purpose of the proposed law is to require manufacturers to place a warning label on their products when needed. An even more important object, in Professor Henderson's opinion, is to provide that manufacturers may submit any proposed material to the surgeon-general of the United States for an opinion as to its safety or dangerousness before putting it on the market.

Dr. Charles H. LaWall, dean of the Philadelphia College of Pharmacy and Science, who was appointed some months ago a member of the International Committee of the Health Council of the League of Nations, to study the subject of opium assay methods, and who was at that time appointed a consultant in pharmaceutical chemistry to the U. S. Public Health Service so that he could legally import the opium upon which the experiments were to be made, has completed the first assignment of the work and sent in his reports to the chairman, Professor L. van Itallie, of Leyden, Holland. Other members of the International Committee are Professors H. Baggesgaard Rasmussen, of Copenhagen; R. Eder, of Zurich; A. Goris, of Paris; E. Knaffl-Lenz and I. Wasserberg,

of Vienna. There is also a member representing Great Britain and one representing Japan.

The American Association of Cereal Chemists will hold its annual meeting on May 23, 24, 25 and 26, at Detroit, with headquarters at the Statler Hotel.

The fifteenth annual meeting of the American Society of Ichthyologists and Herpetologists is being held in Washington from May 5 to 7. Sessions are held at the U. S. National Museum. The local committee consists of Dr. William M. Mann, director of the National Zoological Park; Miss Doris Cochran, of the U. S. National Museum, and Mr. M. K. Brady, of Washington. The annual dinner of the society will be held on Friday evening, May 6. On Saturday there will be a luncheon at the National Zoological Park, in association with the American Society of Mammalogists, followed by a tour of the park in the afternoon.

The scientific session of the American Heart Association will be held on Tuesday, May 10, from 9: 30 A. M. to 5: 30 P. M. in the New Orleans Municipal Auditorium, New Orleans.

A Pacific intersectional meeting of the American Chemical Society, including the local sections of Arizona, California, Idaho, Montana, Nevada, Oregon, Utah and Washington, will be held at the State College of Washington, Pullman, Washington, on June 15 to 18, in connection with the meeting of the Pacific Division of the American Association for the Advancement of Science. Dr. J. L. St. John, of the division of chemistry, Agricultural Experiment Station, Pullman, Washington, is chairman of the program committee. Titles of papers for presentation at this meeting should be in his hands before May 1, 1932.

The annual meeting of the Canadian Medical Association will be held in Toronto from June 20 to 24, under the presidency of Professor Alexander Primrose, who has lately retired from the faculty of the University of Toronto.

The Kentucky Academy of Science held its nineteenth annual meeting at the Eastern Kentucky State Teachers College, Richmond, on April 23. Officers elected were: *President*, Professor George Roberts, University of Kentucky; *Vice-president*, Dr. Robert T. Hinton, Georgetown College; *Secretary*, A. M. Peter, and *Treasurer*, W. S. Anderson, both of the University of Kentucky. *Representative in the Council of the American Association for the Advancement of Science*, Dr. A. R. Middleton, University of Louisville; *member of the Publications Committee*, Dr. J. B. Miner, University of Kentucky. Dr. Irvin Abell, of the University of Louisville, and Dr. Charles E. Spearman, of the University of London, delivered addresses at the general session.

At a meeting of the College of Medicine of the University of Illinois Chapter of Sigma Xi, held on March 30, four members were promoted from associate to active membership, eleven elected to active membership, and twenty-two elected to associate membership. The scientific program consisted of the presentation of the following research work: "The Effect of Heat Sterilization on the Activity of Dried Pollen Extract," Dr. B. Z. Rappaport; "Studies on the Discharge of Bile in the Duodenum," Dr. C. B. Puestow, and "Alterations in Renal Response Following Denervation," Dr. G. Milles. Dr. A. A. Zimmermann, who was the delegate from the chapter, made a report on the national convention, held at New Orleans. The chapter voted that it be suggested to the National Executive Committee that the annual convention in 1933 be held in Chicago.

A meeting of the Society of Chemical Industry will be held jointly with the American Chemical Society, the Electrochemical Society and the Société de Chimie Industrielle on May 13 at 8: 30 P. M., at the Chemists' Club, 52 East 41st St., New York. Dinner preceding the meeting will be served at 7: 00 o'clock. The program will be devoted to the presentation of a paper by Mr. Edgar C. Bain, of the United States Steel Corporation, on "Some Fundamental Characteristics of Stainless Steels."

The Tenth Annual Colloid Symposium will be held at Ottawa, Canada, on June 16, 17 and 18. Dr. Emil Hatschek, of London, will be the guest of honor. He will give a paper on "The Study of Gels by Physical Methods" before the symposium and will deliver a public address on "Jellies" the evening of the first day of the meeting.

The directors of the Alexander Dallas Bache Fund of the National Academy of Sciences, Drs. W. J. V. Osterhout, E. B. Wilson and Heber D. Curtis, *chairman*, made grants in aid of research as follows at the April meeting of the Academy: To Dr. Matilda Brooks, University of California, for collecting Valonia specimens and shipping from Tortugas to Woods Hole; to Frank A. Perret, vulcanologist, Martinique, F. W. I., to assist in building and equipping a volcano laboratory on the slope of Mt. Pelée; to Dr. Robert Hegner, of the Johns Hopkins University, for further research at Panama on the parasites of monkeys; to Dr. N. Bobrovnikoff, Perkins Observatory, for the preparation of a general catalogue of comets, with emphasis upon astrophysical data; to Director Frank C. Jordan, Allegheny Observatory, for the determination of stellar parallaxes from Allegheny plates; to Dr. Charles Kofoid, of the University of California, to continue work done under an earlier grant on the ciliated protozoa of ruminants.

An Associated Press dispatch reports that a cargo of unusual and valuable foreign plant species gathered on an 8,000-mile cruise of the Caribbean Sea has been brought to the United States aboard the yacht of Mr. Allison V. Armour, of New York. Rare palms, new vegetables and species for experiment to develop the production of the Southeast were included in the cargo. The owner of the yacht, *The Utowana*, was accompanied by Dr. David Fairchild, Mr. P. H. Dorsett and Mr. W. F. Loomis, of the staff of the division of cotton and rubber plant investigations of the U. S. Department of Agriculture, and Mr. L. R. Toy, of the new homestead branch experiment station at Florida.

DISCUSSION

WHAT IS A PUBLICATION?

For many years systematists in the botanical and zoological fields have debated, often with considerable acrimony, the subject of what constitutes publication. I wish, as indicated in the title, to direct attention to a slightly different aspect of the problem, namely, to the methods of reproducing manuscript. Prior to the present century an easy and sharp distinction could be made between manuscripts and documents reproduced by use of cast type. There were few or no intermediate processes. But during the past two decades with perfection of appropriate machines a rapidly increasing amount of extensively duplicated material has been issued in typewriter face. Duplicate copies produced by direct manual effort on a typewriter are obviously still to be considered as manuscript. The gelatin-pad processes (hectograph, "ditto," *et cetera*) need not be considered, since the number of copies so produced is limited. It is the printing of typewriter reproduction by forcing ink through a stencil (mimeograph) and the printing of typewriter facsimile by use of roller or ribbon-applied inks (multigraph) which need consideration.

Dr. C. W. Stiles, in his scholarly address to the American Ornithologists' Union in 1927 on "What constitutes publication?"[1] set up the following theoretical definition for a zoological publication: "The manifolding of a dated zoological document which is intended as permanent record and which is made potentially and reasonably available to the populus zoologicus as of the decade of issue" (p. 477). He also touched upon the "methods of manifolding manuscript" and indicated several means of reproduction, including the stencil (mimeograph). But he concluded his brief discussion of this subject by saying "in view of the economic problems involved, I am not prepared to take a definite stand on the question of technique of manifolding manuscript as a condition precedent to recognizing publication" (p. 475).

However, it seems to me that some definite decision must be made with respect to mimeographed and multigraphed materials, particularly those items which agree in other respects with the accepted requirements for publication.

In order to provide a basis for discussion, some of the materials which fall into this controversial field will be described. These items are used merely as examples to illustrate the problem; no reflection is intended on organizations or persons concerned, because of their use of the methods herein discussed.

The U. S. Bureau of Biological Survey has issued a mimeographed series of "Bird Banding Notes," of which 17 numbers appeared between 1922 and 1925. A footnote on the first page of each issue stated that "'Bird Banding Notes' is not a publication and is not for general distribution. It is issued for the information of cooperators of the Biological Survey, but anyone using in a published paper any of the information contained in it will be expected to give credit to the person named and to the Bureau."

In March, 1926, the Biological Survey issued a special report on "Our migratory wild fowl and present conditions affecting their abundance," by E. W. Nelson. This bore a designation "BSR-1 Special Report," as though it were the initial item in a series. The cover is printed in a non-typewriter face; the text is in typewriter face on both sides of the sheet, printed so clearly as to suggest it may have been the product of the movable types of a multigraph machine. In the published history of "The Bureau of Biological Survey"[2] by Jenks Cameron this item is not included in the formal list of publications but is mentioned on p. 219 together with a mimeographed report on effect of rodent poisons on game birds; a footnote says of the latter, "this was published in July, 1927; the wildfowl report in March, 1926."

The Pacific Northwest Bird and Mammal Society [Club to 1922] has since 1920 issued thrice a year, in January, May and September, "The Murrelet," which is stated to be the "official bulletin" of the society. Any person interested in birds or mammals may become a member of the organization upon payment of dues and may purchase back numbers of "The Murrelet." At first entirely mimeographed, a printed

[1] SCIENCE, n. s., 67: 471–478, 1928.

[2] Institute for Government Research, Service Monographs of the U. S. Government, No. 54, 1929.

cover of regular form was added with the issue of January, 1925. Beginning in January, 1930 (Vol. xi, No. 1) text as well as cover is printed. The general form of the earlier mimeographed issues of "The Murrelet" differs in no respect from that of a periodical printed on a letterpress, save for the limitation in type face. "The Murrelet" includes material similar in nature to that appearing in many letterpress journals, such as notes on the distribution, habits and ecology of birds and mammals in northwestern North America. Each issue includes a table of contents, and two 5-year indices have been issued. A sample entry is entitled "Farthest North Record of Fur Seal," by J. F. Bernard ("Murrelet," vi, No. 1, January, 1925, p. 14); it reports the occurrence of a large male fur seal at Sledge Island, near Nome, Alaska, on September 15, 1924. This record is exactly similar to many occurring in printed journals, such as the *Journal of Mammalogy*. "The Murrelet" is included in the "Union List of Serials in Libraries of the United States and Canada," issued by the H. W. Wilson Company, of New York, and sets are reported in ten libraries. Items in "The Murrelet" submitted by members of the U. S. Bureau of Biological Survey are included with other "Articles in Current Publications by Department Workers" in the weekly Official Record of the U. S. Department of Agriculture.

Some years ago Dr. Royal N. Chapman prepared an outline of his course in insect ecology, as given at the University of Minnesota. The "publication," as it is called in the preface, is of 8½ x 11 inch size, consisting of ix + 1–187 + 1–183 pages with table of contents, bibliography and text figures, and is mimeographed. A printed title page bears the legend: Animal Ecology/ with especial reference to/ insects/—/by/ Royal N. Chapman/ The University of Minnesota/—/All rights reserved/—/Burgess-Brooke, Inc./ publishers/ Minneapolis, Minn,/ 1925. [Preface dated June 1926.] The volume is bound with a pressboard cover. It was for sale at a stated price and so reasonably available to the zoological public. Under date of April 22, 1927, Burgess-Roseberry Company (formerly Burgess-Brooke, Inc.) who describe themselves as "mimeograph publishers," announced a second mimeographed edition of this work, to be of 370 pages. Material from these two editions of the mimeographed volume have frequently been cited in current ecological literature, and this "title" has been included in terminal bibliographies. In 1931 a volume from the pen of Dr. Chapman under the same title was issued by a commercial publisher in conventional book form. This is a third edition, much revised.

Were all mimeographed and multigraphed productions similar in form to those already mentioned, little difficulty would be involved concerning their status, but grading downward, there is every conceivable intermediate form until the circular letter is reached! Of intermediate status are the "house organs" and "news bulletins" such as those put out by the Bureau of Biological Survey ("The Survey"), by the California State Department of Agriculture and by the naturalists of several of our western National Parks. Of the latter, the one emanating from Yosemite National Park was first mimeographed and later began appearing in printed form; others from the General Grant and Yellowstone parks are still in mimeographed form. These latter contain original material, often of considerable record value, and are available to a wide public.

The greater convenience and lessened cost of these newer means for duplicating and disseminating information in "periodical" or "book" form have been of increasing importance in this country in the last decade, and there is no reason to suppose that their use will decrease in the future. Many of the documents so produced, from their beginnings, contain original material of sound scientific worth. Their intrinsic value as records of scientific work is indicated by repeated citation in other scientific literature. They have been generally accepted by the large majority of scientific writers as conventional documents equivalent to those printed by movable types and letterpress. Admittedly there may be difficulty in making a distinction between casual announcements, press releases, news bulletins and "house organs" intended for a circulation restricted to the personnel of a particular organization, on the one hand, and, on the other, items such as those specifically described above of either periodical or separate character, which are distributed free or by sale to the interested public, and of which some eventuate in conventionally printed form.

The degree of permanency of a document has not been considered to be a criterion in determining what constitutes publication, since many documents both old and recent, of thoroughly accepted status, have been upon the flimsiest of paper and of a sort to be preserved only with difficulty.

The question, then, of what constitutes a publication seems not to be concerned solely with the mechanism of reproduction, but rather with the character of the document. Difficult and uncertain as will be the problem of segregating out true publications, according to Dr. Stile's theoretical definition quoted above, it seems inevitable that items answering the requirements of that definition, even though they be printed by movable types of typewriter face or by stencils, can not be excluded from the category of publications.

University of California, Davis, California
Tracy I. Storer

THE PATHOGENICITY OF NEISSERIA SICCA

NEISSERIA SICCA is a small gram-negative, aerobic diplococcus. Its growth on agar consists of irregularly round, raised, opaque, slightly yellowish colonies which may reach a diameter of 3 mm. The colonies are dull, dry, with a deeply furrowed surface and a crenated edge. Attempts to remove these colonies show them to be very firm and some of them adherent to the surface of the medium. The removed colony is found to be difficult to disintegrate, and impossible to emulsify. When grown in a liquid medium the organism agglutinates spontaneously. Most of the writers on the subject state that acid, but no gas, is produced from dextrose, maltose, levulose and saccharose. The action on saccharose was delayed in the organism which I studied. Besides the rough type of colony described above, a smooth type has been noticed. Variants of a smooth type were observed in my cultures.

As to the specificity of *N. sicca* and other members of the genus Neisseria found in the nasopharynx, Wilson[1] states:

> It seems probable that the gram-negative cocci of the nasopharynx form a single species within which are a few more or less constant subspecies, each of which is itself subject to variation. Until we know more of the extent of this variation it does not seem justifiable to assign names to the numerous types that have from time to time been described by different investigators.

But this is a controversial point.

Under the title, "Acute vegetative endocarditis with multiple secondary foci of involvement due to M. Pharynitides siccae," Schultz[2] described a case of clinical endocarditis from the blood of which a pure culture of a gram-negative diplococcus was grown. This organism was not agglutinated by polyvalant antimeningococcus serum. Acid, but no gas, was produced from dextrose, saccharose and maltose; there was no reaction in mannite or litmus milk.

Kretschmer and Hufnagel[3] isolated a similar organism from the pus of a kidney at operation.

Recently, I identified *N. sicca* from the blood stream of a boy, 12 years of age, who had been ill with clinical endocarditis for two weeks. He complained of headache; a petechial rash extended over the abdomen, and valvular disease of the heart was present. *N. sicca* was isolated on three occasions from the blood stream. Several cultures made of the spinal fluid proved negative.

Detection of the growth of *N. sicca* in the blood culture made in liquid medium may be readily overlooked, due to the adherence of the organisms to each other, and to its not forming a diffused growth.

Neisseria sicca appears to be a pathogen and more of a clinical entity than we have suspected.

FREDERICK W. SHAW
DEPARTMENT OF BACTERIOLOGY,
MEDICAL COLLEGE OF VIRGINIA,
RICHMOND, VIRGINIA

[1] Wilson, *J. Path. and Bact.*, 31, 477, 1928.
[2] Schultz, *J. A. M. A.*, 71, 1739, 1918.
[3] Kretschmer and Hufnagel, *J. A. M. A.*, 82, 1850, 1924.

CHROMOSOME NUMBERS IN ALTHEA ROSEA

BECAUSE of its economic importance, cotton has been the subject of much cytological investigation. Denham, in 1924, compared the chromosome numbers of the New World and Egyptian cottons with those of the Asiatic varieties. He reports the haploid number of the former as 26 and that of the latter as 13. The chromosome numbers of the other genera of the family have not been reported so far as known.

Flower buds of *Althea rosea* were collected during the summer of 1931 and fixed in various solutions. Chromosomes were counted in both homeotypic and heterotypic divisions and it appears that the haploid number of the species is 13.

Further study of the different genera is planned together with a more detailed cytological work.

GEORGE W. BURKETT
DEPAUW UNIVERSITY

ON "ACADEMIC FREEDOM IN SPAIN"

IN SCIENCE for April 15, Father P. H. Yancey, S.J., suggests a boycott by American educators as a protest against the "brutal attack" on academic freedom perpetrated by the Spanish government in forbidding members of the Jesuit order to teach in Spain, and confiscating their property. Such a statement by an educator and a member of that order deserves notice, since I am unable to understand how academic freedom is directly involved in the issue.

An inclination to comment on this matter is due to my having been born and reared in Spain. I received my education there, graduating from the University of Madrid. I have known rather intimately the conditions which led to the fall of the monarchy, and I have been in touch with the situation in Spain since leaving that country.

The suppression of the Jesuits with the advent of a new order was a foregone conclusion in the minds of both liberal Catholics and dissenters. Certainly, the teaching activities of the members of this order have not been the cause of objection, nor their personal beliefs, which they have been free to express wherever and whenever they chose. The Society of Jesus has been forbidden to carry on its appointed tasks in Spain because its members take, in addition

to three vows which are not objectionable, a fourth vow of absolute submission to a power residing outside the state. The Spanish people through their elected representatives insist on the sovereignty of the state over its subjects, regardless of the form of government, which may be modified by popular will. This attitude, recently emphasized by the arrest and deportation of communist agitators holding membership in the Third Internationale, is in sharp contrast with the complacency of the monarchy, which allowed in its midst groups of nationals engaged in social and political activities while bound by oath to obey a foreign power.

The measures taken by the Spanish government against the Jesuits, although they may incidentally have encroached upon their academic freedom, are, therefore, primarily a national move for self-preservation. In a way they are less severe than they might appear, for it must be remembered that the members of the order were actually expelled from Spain in 1767, not by a republican government, however, but by His Most Catholic Majesty Charles III. The Society of Jesus was expelled from France in 1594, restored in 1603, again expelled in 1764, and for the last time in 1880. Its members have also been expelled at various times from other Catholic communities, and the order suppressed in 1773 by Pope Clement XIV, but it was revived in 1814.

One may question the wisdom of such harsh measures, but in so far as they are aimed not at individuals but at groups or corporations whose activities may ultimately be inimical to the sovereignty of the state, they do not fall under the category of attacks on academic freedom as it is generally understood.

JOSÉ F. NONIDEZ

CORNELL UNIVERSITY MEDICAL COLLEGE

REPORTS

RECENT WORK ON AMERICAN INDIAN LANGUAGES

FOR a long time students of the American Indians have felt the need of more intensive work on American linguistics. After the attempts of Dr. Albert Gallatin to give a summary of distribution of American languages in the *Transactions* of the American Ethnological Society, the problem was taken up anew by Daniel G. Brinton, who worked particularly on the manuscripts accumulated in the University of Pennsylvania and published the Library of Aboriginal American Literature; and by J. G. Shea in his "Library of American Linguistics," Volumes 1 to 13. The Bureau of American Ethnology collected the data for Powell's Linguistic Map of North America and continued from time to time the publication of text material in various Indian languages. A more systematic attempt at a presentation of the fundamental structures of American Indian languages was not made until in Bulletin 40 of the Bureau of American Ethnology a series of grammatical sketches of American Indian languages were presented. In the time between 1911–1922 the following sketches of language were published in this bulletin:

Athapaskan, by Pliny E. Goddard
Tlingit, by John R. Swanton
Haida, by John R. Swanton
Tsimshian, by Franz Boas
Kwakiutl, by Franz Boas
Chinook, by Franz Boas
Maidu, by Roland B. Dixon
Algonquian, by William Jones and Truman Michelson
Dakota, by Franz Boas and John R. Swanton
Takelma, by Edward Sapir
Coos, by Leo J. Frachtenberg
Siuslawan, by Leo J. Frachtenberg
Chukchee, by Waldemar Bogoras

During the same period the collections of texts in American languages increased considerably. The American Ethnological Society published a series of thirteen volumes; and Columbia University, the University of California, the American Museum of Natural History, the Bureau of American Ethnology, the University of Washington, Seattle, and the Geological Survey of Canada also published considerable text series.

Work on American languages was taken up more systematically and energetically when the American Council of Learned Societies included this work in its program and interested the Carnegie Corporation in it. The American Council of Learned Societies was able to give considerable financial support to this undertaking through appropriations made for the purpose by the Carnegie Corporation. A Committee on Research in Native American Languages was appointed consisting of Franz Boas, *chairman,* Leonard Bloomfield and Edward Sapir to carry on the work with the help of a general committee consisting of M. J. Andrade, J. de Angulo, Father Berard, R. B. Dixon, J. P. Harrington, M. Jacobs, D. Jenness, A. V. Kidder, A. L. Kroeber, T. Michelson, F. M. Olbrechts, G. A. Reichard, F. G. Speck and J. R. Swanton. Since the period for which the committee was first established has reached its end it seems appropriate to make a general statement in regard to the field work accomplished and the material published.

The following is a summary report of the Committee covering the period from 1927 to 1931. Some of these investigations have been carried on in cooperation with other agencies.

It has been the endeavor of the committee to fill in the most important gaps in our knowledge of American languages. This required field investigations on languages which are on the verge of extinction, revision of older, inadequately reported languages, and attempts at dialectic studies with a view of laying a basis to historical studies of the development of various groups. The last named problem is so large that it was impossible to undertake it in a systematic way.

The selection of fields of work was also necessarily determined by the interests and training of the available investigators.

Work on vanishing languages was done particularly in Oklahoma and on the Pacific Coast. Under this item may be enumerated:

Kitsai and Wichita, by Dr. Alexander Lesser
Tonkawa, by Dr. Harry Hoijer
Yuchi, by Dr. Günter Wagner
Catawba, by Dr. Frank G. Speck
Mohican, by Miss Olive Eggan
Tillamook, by Miss May Mandelbaum
Nootsak, by Dr. Thelma Adamson
Kalapuya, Molala, and Cayuse, by Dr. Melville Jacobs

A number of Pacific Coast languages, although not exactly on the verge of extinction, nevertheless belong to this group. I mention under this head:

Quileute, by Dr. Manuel J. Andrade
Yokuts, by Mr. Stanley S. Newman
Patwin and Wappo, by Dr. Paul Radin
Wishram and Washo, by Mr. Walter Dyk
Atsugewi, Achumawi, Shasta, Karok, by Dr. Jaime de Angulo
Karok, by Mr. John P. Harrington
Pomo, by Dr. Jaime de Angulo
Zuni, by Dr. Ruth L. Bunzel
Yuki, by Dr. Alfred L. Kroeber
Maidu and phonetics of northern California languages, by Mr. Hans J. Uldall

Material on linguistic groups was collected as follows:

Athapaskan
Chippewyan, Hare, by Dr. Fang-Kuei Li
Wailaki, Mattole, by Dr. Fang-Kuei Li
Wailaki, by Dr. Pliny E. Goddard
Lipan, Mescalero, by Dr. Harry Hoijer

Here should be mentioned Professor Sapir's continued study of Athapaskan dialects and his own and Father Berard's studies of Navaho.

Siouan
Dakota, by Miss Ella C. Deloria
Winnebago, by Dr. John Broderius
Crow, by Dr. Robert H. Lowie
(Catawba, by Dr. Frank G. Speck, mentioned before)

Salish
Coeur d'Alêne, by Dr. Gladys A. Reichard
Thompson, by Miss Elizabeth Dijour
Cowlitz, by Dr. Thelma Adamson
Chehalis, by Dr. Franz Boas
Moses Columbia, by Miss Velpha Walters
(Nootsak and Tillamook, mentioned before)

Caddoan
Pawnee, by Dr. Gene Weltfish
(Kitsai and Wichita, mentioned before)

Sahaptin
Klickitat, by Dr. Melville Jacobs
Sahaptin, by Mr. Verne Ray
Nez Percé, by Mr. Archie Phinney

Wakashan
Nitinat, by Mr. Morris Swadesh
Kwakiutl, by Dr. Franz Boas
Bella Bella, by Dr. Franz Boas

Muskokian
Creek, by Mr. Vic Riste
Natchez, by Mr. Vic Riste

Iroquois
Cherokee, by Dr. Frans M. Olbrechts
Iroquois, by Dr. Frans M. Olbrechts

Miscellaneous
Pame (or Chichimeco, Mexico), by Dr. Jaime de Angulo
Zapotec, by Dr. Paul Radin
Otomi, by Dr. Paul Radin
Tlappanec, by Dr. Paul Radin
Kechua, by Miss Elizabeth Dijour
Pipil, by Prof. Leonhard Schultze-Jena
Cora, by Prof. Theodor Preuss
Aleut Text and Grammar, by Mr. Waldemar Jochelson

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Sahaptin Texts. Melville Jacobs. Publications, University of Washington, Vol. ii, No. 6, pp. 175–244.

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Religion of the Kwakiutl. Franz Boas. Columbia University Contributions to Anthropology, Vol. x, Pt. 1, pp. xviii, 284; Pt. 2, pp. viii, 288.

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Zuñi Ritual Poetry. Ruth L. Bunzel. Bureau of American Ethnology. In press.

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The Yawelmani Dialect of Yokuts. Stanley S. Newman. *International Journal of American Linguistics*, Vol. vii, pp. 85–89.

Notes on Some Recent Changes in the Kwakiutl Language. Franz Boas. *International Journal of American Linguistics*, Vol. vii, pp. 90–93.

Cherokee Texts. Frans M. Olbrechts. Bureau of American Ethnology. In press.

READY FOR PUBLICATION

Zapotec Texts with Translation. Paul Radin.
Chippewyan Stems and Grammar. Fang-Kuei Li.
Tonkawa Grammar. Harry Hoijer.
Wishram Verb Stems. Walter Dyk.
Grammatical Notes on Tlappanec. Paul Radin.

MATERIAL BEING WORKED UP

Yokuts Comparative Grammar. Stanley Newman
Wishram Grammar. Walter Dyk.
Quileute Grammar. Manuel J. Andrade.
Yuchi Grammar. Günter Wagner.
Catawba Texts. Frank G. Speck.
Tillamook Texts and Grammar. May Mandelbaum.
Sahaptin Texts. Melville Jacobs.
Aleut Grammar. Waldemar Jochelson.
Zuñi Grammar. Ruth L. Bunzel.
Wailaki Grammar and Texts. Fang-Kuei Li.
Chippewyan Texts. Fang-Kuei Li.
Hare Grammar and Texts. Fang-Kuei Li.
Tonkawa Texts and Dictionary. Harry Hoijer.
Apache Grammar and Texts. Harry Hoijer.
Wishram Dictionary. Walter Dyk.
Washo Grammar and Texts. Walter Dyk.
Creek Grammar and Texts. Vic Riste.
Natchez Material. Vic Riste.
Notes on Mohican. Olive Eggan.
Winnebago Grammar and Texts. John Broderius.
Nitinat Grammar and Texts. Morris Swadesh.
Thompson Grammar and Texts. Elizabeth Dijour.
Patwin. Paul Radin.
Kitsai Grammar and Texts. Alexander Lesser.
Nez Percé Texts. Archie Phinney.
Teton Grammar, Dictionary and Texts. Ella Deloria.
Cayuse Vocabulary. Melville Jacobs.
Crow Grammar and Texts. Robert H. Lowie
Pawnee. Gene Weltfish.
Maidu, and Northern California Phonetics. Hans J. Uldall.
Pomo. Jaime de Angulo.
Yuki. Alfred L. Kroeber.
Zuñi Texts. Ruth L. Bunzel.
Cherokee and Iroquois. Frans M. Olbrechts.
Pipil. Leonhard Schultze-Jena.
Aleut Texts. Waldemar Jochelson.
Siberian Eskimo Grammar. Waldemar Bogoras.

While a considerable amount of work has been accomplished, much remains to be done to preserve the vanishing languages which will be required for later studies, and to record those languages which occupy key position in the various stocks. The exigencies of the situation make it quite impossible to carry through systematic investigations of those linguistic stocks that have developed the greatest number of markedly distinct dialects, although we may hope to learn from this material most in regard to the history of American languages. On the other hand, there are so many languages the linguistic position of which is still entirely doubtful that it was necessary to pay attention rather to these than to others. It has long been recognized that studies of this kind should be extended over Latin-America. If the work of the committee, as it is hoped, will be continued beyond the present year, the problem of extending the work over the vanishing languages of Latin-America ought to be kept in mind.

FRANZ BOAS

COLUMBIA UNIVERSITY

SCIENCE SERVICE CONFERENCE[1]

ARE the social sciences really sciences? Can economics and the other studies that bear immediately and intimately on human affairs be handled with the same detached objectivity that is possible to a physicist or to a biologist? This question became the subject of a brief friendly debate between a noted physicist and an equally noted economist at the dinner following a conference called by Science Service to discuss possible improvements in the transmission to the public of scientific news and information.

The question was first raised during the afternoon conference by Robert P. Scripps, editorial director of the Scripps-Howard Newspapers, whose father, the late E. W. Scripps, was the founder of Science Service. The ruling idea in his father's mind when he launched the enterprise, Mr. Scripps said, was to benefit humanity by the wider dissemination of scientific knowledge and method; and he suggested, as in line with this tradition, the possible advisability of adding the so-called social sciences to the scope of Science Service's work.

In his evening address, Professor Robert A. Millikan, director of the Norman Bridge Laboratory of the California Institute of Technology, expressed frank doubts as to whether the social sciences are really scientific. The thing that really characterizes a science, he said, is the existence of a large body of facts, a universally accepted doctrine. A science such as physics, he pointed out, is based on such a body of facts, and though this basis may be added to, the later additions work no essential change in the earlier known truths. There is, of course, always a margin of disagreement, usually over new developments, but as compared with the main body of the science this is very narrow indeed.

In economics and the other social sciences, Dr. Millikan held, an exactly opposite condition obtains. The body of agreed-on doctrine is vanishingly small, and the field in which experts disagree comprises almost the whole of the science. Furthermore, the disagreement extends beyond questions of fact into the lightning-charged field of the emotions and human passions, so that the conflicts arising therein are much more intense than they are in the more academic realm of the physical sciences. For this reason, the speaker concluded, it would seem inadvisable, perhaps dangerous, for an organization like Science Service to undertake an extension of its activities into the social science field at the present time.

Dr. H. G. Moulton, president of the Brookings Institution, Washington, D. C., spoke as an active champion of the social sciences, both as having an intimate and potentially useful bearing on human life and as being susceptible to a really scientific approach. Economics was once as definite a science as physics, he said, at least so far as having a definite basis of agreed-on doctrine is concerned. It has only been during the past one or two generations that this apparently solid basis has been dissolved by the revolutionary changes brought about by recent world events. The facts of economics and the other social sciences are still there, he insisted, and still capable of the impartial and objective treatment demanded by true scientific method. He felt that they constitute a challenge to an institution for the popular dissemination of knowledge, like Science Service, and that work in this field would be a quite proper undertaking.

The remaining discussion during the evening session was given an entirely different turn by Dr. John H. Finley, editor of the *New York Times*. He spoke of the problem from an editor's angle, stressing the constant necessity of working with speed yet with accuracy, of maintaining a balance of material selected, of watchfulness against propaganda from any source, and of the editor's need to "know a little about everything, and to know where to turn to find out everything about anything."

Dr. William H. Welch, dean of the medical faculty of the Johns Hopkins University, presided at the evening meeting.

During the afternoon session, a succession of five-minute talks by various eminent scientists and representatives of the press set forth a symposium of views on the more immediate problems involved in getting correct information on scientific advances and scientific methods before the general public. The conference was held in the building of the National Academy of Sciences, immediately after the close of the spring meeting of the Academy, and a majority of the scientists present were members of that organization, often called "the Senate of American Science."

In opening the discussion, Dr. J. McKeen Cattell, editor of SCIENCE and president of Science Service, paid a tribute to the late E. W. Scripps and to Dr. William E. Ritter, of the University of California, as co-founders of Science Service. "If Scripps was the Charlemagne who could do all this with a high hand, Ritter was the Alcuin who advised him." Attention was also called to the part taken in the founding of the service by Drs. George E. Hale, Robert A. Millikan, A. A. Noyes and Vernon Kellogg and the invaluable work of the first director, Dr. Edwin E. Slosson.

Then, in rapid succession, the scientists and newspaper men voiced their opinions and suggestions.

Dr. Simon Flexner, director of laboratories of the Rockefeller Institute for Medical Research, New York

[1] Reported by Science Service.

City, spoke of the need for more than ordinary precaution in handling medical news, and suggested the advisability of submitting all items to an advisor well qualified in medical science before publication.

Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, expressed the wish that scientific institutions and organizations might "feed in" important and desirable news items, so that they may receive prompt and adequate public notice.

Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, spoke on the necessity of informing people not only on new scientific discoveries but on scientific method and outlook as well. The rulers of the world are uninformed of the natural forces that control the world, he said, and much of the present crop of disastrous legislature is such simply because it runs counter to natural laws. If it is to be avoided and wise laws passed, the lawmakers must be given the information they need.

A. H. Kirchhofer, editor of the Buffalo Evening News, spoke as a representative of the press. He asked for more mutual tolerance and patience between scientists and newspapermen, and expressed the belief that news stories on scientific subjects would be more satisfactory both to editors and to scientists if the latter would give intelligent reporters their cooperation.

Dr. John C. Merriam, president of the Carnegie Institution of Washington, after warning newspapermen against trying to make "good copy" and big headlines out of researches still in the discussion stage, concluded with the suggestion that the knowledge of interest by the public in such unfinished problems may stimulate scientists to express their findings more clearly and understandably when they finally reach them.

Dr. A. A. Noyes, director of the Gates Chemical Laboratory of the California Institute of Technology, made two suggestions: first, the desirability of making clear the evidential status of any announcement put forth as a news item; second, the possibility of using younger scientists in the various laboratories and universities as local correspondents.

Professor E. B. Wilson, of Harvard University, called attention to the differing aspects of the concept of accuracy, depending on the audience to whom a given scientific discovery or fact is to be presented. Details that are absolutely essential before a group of scientists may only befog the picture if they are used before a lay audience, and thus destroy instead of make for accuracy in the image that gets into the minds destined to receive it.

Dr. Charles G. Abbot, secretary of the Smithsonian Institution, registered strong approval of a new Science Service enterprise, the distribution of low-priced phonograph records giving brief talks by leading scientists, and expressed the hope that further issues of this sort would be made.

Dr. W. F. G. Swann, director of the Bartol Research Foundation of the Franklin Institute, Philadelphia, voiced his faith in the ability of "the man in the street" to understand science if it is properly presented to him. "I would much rather talk about relativity to an intelligent lawyer or an intelligent clergyman than to a bad physicist," he said.

Dr. Francis G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution of Washington, in Boston, stressed the desirability of care and accuracy in reporting medical discoveries, because of the great immediate importance of these to human life, and the possible lamentable consequences of even apparently minor error.

Dr. Paul R. Heyl, of the U. S. Bureau of Standards, suggested that general summaries or reviews of progress in science might be well received, and would be useful to scientists as well as to the lay public.

Professor A. E. Kennelly, of Harvard University, called attention to possible errors of impression that readers might receive if undue emphasis is placed on the wrong point in reporting a scientific discovery or event. He also made a plea for the expression of quantitative results in the metric system, which he termed "the international language of science."

Professor Charles R. Stockard, of Cornell Medical College, reinforced previously expressed pleas for a high degree of accuracy in reporting medical news. He further suggested the desirability of explaining properly how animal experimentation is used in working out medical advances, as a counter to anti-vivisection propaganda.

Professor Joel H. Hildebrand, of the University of California, expressed his desire that science articles intended for the general public give not merely the news of discoveries but that they also stress the importance of the scientific method in thinking and working.

Dr. T. Wayland Vaughan, director of the Scripps Institution of Oceanography, La Jolla, California, declared that his relations with the press had always been satisfactory, because he was willing to meet intelligent newspapermen half way. He recommended cooperation to his fellow-scientists.

Professor Richard M. Field, Princeton University geologist, called attention to the natural interest of the public in the economic aspects of science, and in economic questions generally.

Dr. F. P. Keppel, president of the Carnegie Corporation, commended Science Service for having "stuck to its last," and said he hoped it would continue to do so.

Dr. F. G. Cottrell, chemist and inventor of the precipitation process, laid fresh emphasis on the necessity of presenting science as news to newspapers.

Capt. J. F. Hellweg, of the U. S. Navy, spoke briefly on "what should not be printed."

Professor Knight Dunlap, of the Johns Hopkins University, contrasted conditions in science news reporting since Science Service entered the field with what they were before that time, and expressed the hope that this organization would continue its work independently, not only for the work it is doing itself but for its stimulating effect on the science reporting of the other newspaper syndicates.

Dr. W. H. Howell, of the Johns Hopkins Medical School, chairman of the executive committee of Science Service, closed the discussion with an expression of thanks to his fellow-scientists for their cooperation in the work of Science Service.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CRITIQUE OF THE SERIAL DILUTION METHOD FOR QUANTITATIVE DETERMINATION OF BACTERIOPHAGE

The two current methods for quantitative determination of bacteriophage are the plaque count and the serial dilution technique. The latter procedure involves testing successive dilutions of the lytic principle for ability to produce visible lysis of a broth culture of susceptible bacteria. The final effective dilution is assumed to contain at least one phage particle and the titre of the original lysate is calculated upon this basis.

For the plaque count, phage dilutions are plated upon a substrate of susceptible organisms. The resulting punched-out, bare areas in the surface growth are considered to represent the loci of single phage particles. Their number, together with the dilution factor, should theoretically furnish a simple means of estimating the total phage/ml. in the sample.

That agreement between the two methods above outlined is far from satisfactory for quantitative work is apparent from a survey of the literature. Further, the use of either procedure alone does not permit of accurate comparative determinations. In the case of the plaque count it has been pointed out by Bronfenbrenner [1, 2] that there are several factors not amenable to ready control which effect the formation of plaques; consequently, checks are difficult to procure.

The serial dilution technic presents similar limitations. Clark[3] has analyzed the method upon purely statistical grounds and concludes that with a dilution factor of 0.1 only 60 per cent. of parallel runs on the same solution should give an identical end-point. It is shown in the present paper that some of the difficulties encountered in practical application of the method are explicable on the basis of the kinetics of the bacterium-bacteriophage reaction.

The chief points established regarding the mechanism of phage action, as exemplified by susceptible Staphylococci growing in the presence of anti-Staphylococcus phage, may be briefly summarized as follows:

(1) Phage formation is conditioned by bacterial growth.[4]

(2) The percentage rate of increase in phage is proportional to the percentage rate of increase of bacteria, *i.e.*,

$$\frac{dP}{Pdt} = C\frac{dB}{Bdt}.$$

(3) Phage accumulates within the bacteria, meanwhile maintaining equilibrium with phage in the broth outside the cells, until a certain concentration of phage per bacterium is attained, when lysis ensues. There is thus a definite lytic threshold.[4, 5]

(4) Phage is distributed between susceptible cells and the fluid medium in two ways depending upon whether the bacteria are alive or dead. With live cells (resting or growing) distribution is of normal type and diffusion of phage, into or out of the organisms, proceeds according to a definite quantitative relationship. If the cells are dead, however, they adsorb phage irreversibly and equilibrium may be represented in terms of the Freundlich adsorption isotherm equation.[6]

The purpose of the serial dilution procedure is to ascertain the highest effective phage dilution capable of initiating visible lysis in the test suspension and consequently the technique has been assumed to rest upon a qualitative test for the presence of phage. However, in the case of the organism and phage studied, the qualitative test is conditioned by definite quantitative factors and in effect does not determine whether phage is present or absent in the higher dilutions but rather whether or not a certain minimum quantity of phage is present. This amount is not constant but varies with test conditions.

Consideration of two cases will clarify the above statement. Keeping in mind the dependence of lysis upon development of a certain high intracellular con-

[1] J. Bronfenbrenner and C. Korb, *J. Exp. Med.*, 42, 483, 1925.

[2] J. Bronfenbrenner and C. Korb, *Proc. Soc. Exp. Biol. and Med.*, 21, 315, 1924.

[3] H. Clark, *J. Gen. Physiol.*, 11, 71, 1927.

[4] A. P. Krueger and J. H. Northrop, *J. Gen. Physiol.*, 14 (No. 2), 223, 1930.

[5] J. H. Northrop and A. P. Krueger, *J. Gen. Physiol.*, (in press).

[6] A. P. Krueger, *J. Gen. Physiol.*, 14 (No. 4), 493, 1931.

centration of phage per bacterium, it follows that with a large initial concentration of phage ($[P]_0$), the initial concentration of bacteria ($[B]_0$) may be varied within rather wide limits and lysis will still occur. That is, relatively few cell divisions will result in the production of enough phage to raise the phage-bacterial ratio to the lytic level. This has been demonstrated experimentally.[4]

On the other hand, if $[P]_0$ is small as must obtain in the last few tubes of the serial dilution set-up, it is clear that the magnitude of $[B]_0$ will considerably influence the outcome. A certain minimal number of cell divisions will be required to raise [P] to the effective threshold for lysis and if $[B]_0$ is too large the organisms will enter the maximal growth stationary phase before such a condition is realized. For a given small $[P]_0$ there thus exists a maximal $[B]_0$ beyond which lysis can not be expected to occur. Again, experimental confirmation is direct. With $[P]_0$ small and constant in a series of tubes, successively larger $[B]_0$'s are added under conditions described in previous work.[4] Cellular dissolution results in all the lower members of the series up to a certain point beyond which the suspensions do not clear.

That phage may have been present in the uncleared tubes can be demonstrated by filtering these suspensions and again seeding them with identical $[B]_0$'s. Frequently two or three of the second series will lyse, indicating that phage was originally present but in such small amounts that the lytic threshold was unattainable. However, bacterial reproduction resulted in an appreciable increase in [P] (proven by direct titration) and the second passage upon susceptible organisms developed a concentration adequate for lytic action.

Since development of the lytic end-point depends upon the initial concentration of bacteria used in seeding the test series, the serial dilution technique as usually carried out presents a potential source of error. The customary assumption that the final effective dilution contains one phage particle and the unlysed tubes no such particles is substantially in error and it should be recognized that the titration data can not be expressed accurately in terms of actual lytic particles. Most work does not necessitate absolute enumeration. Nevertheless, in order to make even comparative quantitative determinations of phage, $[B]_0$ should be carefully controlled.

At least one other factor significantly influences the test; namely, the percentage of dead bacteria present in the suspension. Dead cells adsorb phage quickly, irreversibly and in relatively large amounts under ordinary test conditions.[6] Hence their presence will delay, and may readily prevent altogether, the development in live cells of the critical lytic P : B ratio. Dead cells can not be entirely excluded, but it is rational to limit their numbers to a small and rather constant percentage of total cells by employing young cultures of the same age.

The writer has described a method for comparative quantitative phage determinations possessing none of the objections to which the plaque count and serial dilution technique are open.[7, 8] The procedure is based upon a relationship between $[P]_0$ and the time of lysis predicted by kinetic analysis of the bacterium-bacteriophage reaction.[4] Experience with over 200 routine titrations has demonstrated that [P] can be determined with an accuracy of ± 3 per cent.

A. P. Krueger

University of California

A SIMPLE METHOD OF REARING AND MOUNTING HOOKWORM[1] LARVAE

In an effort to partially meet the demands for suitable and adequate laboratory materials for students in biology, the writers have developed a simple method of rearing and mounting hookworm larvae. While the procedure is in part a modification of older methods the technique is very simple, requiring little or no special equipment, and is thus an improvement over the older methods. It is possible by this method to supply large numbers of students with living and mounted specimens of this important human parasite with a minimum amount of trouble to the instructor. This is especially true in the Southern states, where hookworm reservoirs are relatively easy to locate.

Rearing

The usual method of mixing infected feces with powdered charcoal in the proportions of approximately two parts of charcoal to one part of feces was used in rearing larvae. Both animal and plant charcoal were used with equally good results. Suitable containers, such as flat-bottomed watch glasses, were filled with the charcoal mixture and placed in larger shallow pans containing water about one fourth of an inch deep. Each pan was then covered with a plate of glass and the material was incubated at room temperature until the larvae reached the desired stage.

Two general methods of isolating larvae were used. In the first method the material remained undisturbed for a week or ten days until many of the infective larvae had migrated from the fecal material into the surrounding water. The water was then strained through several layers of cheese-cloth into a specially arranged funnel, and the lower contents of the fun-

[7] A. P. Krueger, *J. Gen. Physiol.*, 13, 557, 1930.
[8] A. P. Krueger, Science, lxxii, 1872, 507, 1930.
[1] *Necator americanus.*

nel drained off after a period of 6 to 10 hours. The second was a modification of Baerman's[2] method to permit the isolation of larvae at any stage of their development. In this procedure a heavy wire was bent into a circle of such diameter as to fit into a large funnel and rest on the sides about two inches from the top. Four layers of cheese-cloth were stretched over the wire ring with the edges of the cloth raised so as to form a crude flat bottomed bag. The watch glasses containing the fecal material were inverted on the bottom of the bag; it was then fitted into the funnel which contained enough water to cover the watch glasses. The funnel was equipped with rubber tubing and a stopcock at the lower end and was mounted on a suitable stand. This arrangement of the funnel was the same as that referred to in the first method of isolation.

The larvae that collected over night in the stem of the funnel were drawn off through the stopcock into vials about one inch in diameter and two or more inches deep. The larvae rapidly settled to the bottom and could be obtained in large numbers for classroom study or for mounting. The writers, using a single drop of material, have observed more than forty individuals in the same field of a 100-magnification compound microscope.

Vials of living larvae were kept in the laboratory for about three weeks; they could be kept for longer periods. It was necessary, however, to pipette most of the water off and replace it with fresh water daily to prevent the larvae from dying.

MOUNTING

In preparing larvae for mounting, alcohol was used as a killing and hardening agent. Most of the water was drawn out of the vial and the vial filled with 5 per cent. alcohol. After standing fifteen minutes, the 5 per cent. alcohol was replaced with 70 per cent. alcohol. The larvae were hardened within two hours and remained in this solution, in good condition, for more than two weeks.

The larvae were mounted by transferring a drop of material from the bottom of the vial to a slide. The alcohol on the slide was immediately ignited and allowed to burn off, thereby affixing the larvae. The mount was then placed under a pair of binoculars and any large pieces of débris were removed with a needle, after which the larvae were covered with Delafield's Haematoxylin. After staining 10 to 15 minutes, the excess haematoxylin was flushed off with water running slowly from the tap; only a few seconds were required for the washing. The slide was again placed under the binoculars to see that the desired depth of color had been obtained, and was allowed to dry thoroughly. The larvae were then mounted under balsam in the usual manner.

Congo red, Orange G and alum cochineal were also used successfully as stains, but the larval structures were more distinct when haematoxylin was used.

F. S. ARANT
ROGER KNAPP
DEPARTMENT OF ZOOLOGY-ENTOMOLOGY,
ALABAMA POLYTECHNIC INSTITUTE

[2] G. Baerman, "Über Ankylostomiasis deren Ausbreitungsbedingungen durch die Bodeninfection und deren Bekaempfung." Geneeskundig Tijdschrift voor Nederlandsch-Indie, 57, 579–673, 1917.

SPECIAL ARTICLES

STIMULATIVE EFFECTS OF ILLUMINATING GAS ON TREES

IN an investigation to determine significant symptoms of illuminating gas poisoning of shade trees a series of stimulation phenomena have been observed and recorded during February and March, 1932. The general features of these responses will be described briefly at this time since they may have application during the early spring in the detection of shade trees undergoing the incipient stages of illuminating gas injury.

In the investigation so far, no attempt has been made to determine how small an amount of illuminating gas will give responses in the plant material used. Entire potted trees, tree buds, tree roots, cuttings of shrubs and tree seeds have been subjected to complete atmospheres of illuminating gas and to atmospheres containing 10 per cent. to 40 per cent. of this gas by volume. The commercial product of the New Haven Gas Light Company was used throughout. This gas is a mixture of coke-oven gas and water gas.

When small potted dormant black oak, red oak and catalpa trees were subjected in a closed ash can to an atmosphere containing approximately 20 per cent. of illuminating gas for 24 and 48 hours, respectively, and then placed in a greenhouse, the buds of the gassed trees began to swell and the leaves to unfold weeks before similar control trees showed any bud activity. The exact gain in time cannot be stated as yet because the control trees at this time (a period of 4 weeks) are still dormant.

When test-tubes filled with illuminating gas were sealed over the dormant terminal buds of potted red and black oak trees for one and two days, respectively, active bud development and foliage production was observed weeks in advance of these responses in control trees. The buds of the control trees were en-

encased in test-tubes in an atmosphere of air. Buds encased for 4 and 8 days, respectively, in illuminating gas were inhibited in their development or killed.

When the roots of dormant, potted red and black oak trees were washed free of soil and sealed in an atmosphere of illuminating gas with the stems and buds exposed to greenhouse air, the buds were hastened into active growth 3 to 4 weeks before those of control trees whose roots were sealed in an atmosphere of air. The roots of the gassed oak trees developed a large number of hypertrophied lenticels. Ailanthus trees treated in a similar manner did not show hypertrophied lenticels; the tap-roots of these trees split wide open due to the proliferation of parenchymatous cells. Information upon the behavior of the roots of American elm, Norway maple, sycamore, catalpa, white pine, red pine and bald cypress in atmospheres of illuminating gas has also been obtained.

When the soil-free roots of foliaged red and black oak trees were subjected to a sealed atmosphere of illuminating gas for one day and then repotted in soil, a slight wilting of the leaves occurred, followed by complete recovery. However, when the roots were so exposed for 2, 3, and 7 days, respectively, marked epinastic growth of the oak leaf petioles occurred and wilting of the tips and margins of the leaves took place. Within a few days, drying of the wilted tissue was observed together with a complete loss of leaf pigments proceeding from the distal ends of the leaves to the basal ends.

When dormant cuttings of Forsythia and lilac were enclosed in an atmosphere of illuminating gas for periods of 15 minutes up to 4 days, the shorter exposures hastened flower and leaf bud development and opening. The longer exposures inhibited or killed the terminal buds. In several experiments, gassed Forsythia cuttings developed few or no flowers but the leaf buds developed first and produced apparently normal leaves. At this time, a month after the exposures of the cuttings of Forsythia and lilac to gas, the cuttings exposed the longest periods are developing leaves from the lower buds and callus development is proceeding at the bases of the cuttings. The control cuttings have shriveled and died.

When dormant acorns of red, scarlet and black oaks were subjected to an atmosphere of illuminating gas for periods of 6 hours up to 4 days, respectively, a slight slowing of the rate of germination of the red oak acorns gassed the longest periods was observed. The black oak acorns, apparently the most dormant of the group, were distinctly hastened in their rate of germination by the longest exposures to illuminating gas.

The investigation is being continued with the object of determining the constituent or constituents of illuminating gas that may be responsible for the several plant stimulation responses recorded. Particular attention will be given to a study of the effects of known mixtures of oxygen, carbon dioxide and ethylene upon trees.

Carl G. Deuber

Osborn Botanical Laboratory,
Yale University

OBSERVATIONS ON TASTE BLINDNESS

It has been noted by Fox[1] that individuals vary to a remarkable degree with regard to their capacity to taste para-ethoxy-phenyl-thio-urea, 40 per cent. of the individuals he examined failing to find the substance bitter. These observations have been confirmed by Blakeslee[2] and Snyder.[3]

The latter two authors found that this difference in reaction to taste is inherited and that, genetically, taste deficiency is due to a single recessive gene (Snyder). In an examination of 100 families Snyder finds nine in which both parents and all the 17 children failed to perceive the bitter taste, and Blakeslee reports three matings with eight children, all of whom were non-tasters. The suggestion is also made that the test may be used in cases of disputed paternity in the same way as the blood groups (Blakeslee).

The findings quoted led to an investigation on possible racial differences as regards taste blindness. We have examined the incidence of tasters and non-tasters among American Indians at the Haskel Institute in Lawrence, Kansas. One hundred and eighty-three full-blooded Indians were tested, and of these 6 per cent. were non-tasters. Among 110 Indians with some white admixture there were 14, or 10.4 per cent., non-tasters. The incidence of non-tasters among the white population (150 individuals) in Lawrence, Kansas, was 42 per cent. The latter figure is to be compared with 32.2 per cent. non-tasters among 283 white individuals (Blakeslee), and 31.5 per cent. non-tasters among 440 white individuals (Snyder).

These results indicate another property in addition to the Landsteiner blood groups and the factors M and N which differ considerably in frequency in the American Indians, as compared to that of the white population.[4, 5, 6, 7]

1 A. L. Fox, *Science*, 73, supplement, p. 14, April 17, 1931.

2 A. F. Blakeslee and M. R. Salmon, *Eugenical News*, 16, 105, 1931.

3 L. H. Snyder, *Science*, 74, 151, 1931.

4 A. F. Coca and O. Deibert, *Jour. Immunol.*, 8, 478, 1923.

5 L. H. Snyder, *Am. Journ. Phys. Anthropol.*, 9, 233, 1926.

6 C. Nigg, *Jour. Immunol.*, 11, 319, 1926.

7 K. Landsteiner and Ph. Levine, *Jour. Immunol.*, 16, 123, 1929.

In addition it may be of interest to put on record the results of tests in two among a number of families[8] examined in which the results vary from those already published.

In one family both parents found the substance tasteless in each of three different tests, the father stating on two of these occasions that the substance was not at all bitter but only very slightly sour. Of the six children tested, five found the substance to be very bitter, the sixth child reporting the substance to be tasteless. On a retest of two of the children (one of whom was a non-taster), the results were confirmed.

In the second family the father found the substance to be very slightly bitter, remarking that he hardly would have noticed the taste. The mother found the substance tasteless. Of the six children tested, four children, the two oldest and two youngest, reported the substance to be tasteless, while two children, nine and seven years, respectively, found it to be bitter, in one case very bitter.

The parents and the children in each of the two families seemed to be quite intelligent and their responses to the test were definite. In neither of the two families was any suspicion of illegitimacy, either from the history or from blood tests.

It may be worth while mentioning that in his study Blakeslee found individuals who did not perceive a bitter taste but noticed a taste of another sort.

PHILIP LEVINE
NEW YORK
ARTHUR S. ANDERSON
LAWRENCE, KANSAS

THE DISTRIBUTION OF CAECAL SPIROCHETES

FOLLOWING the studies made on spirochetes in chickens,[1] further observations have been made on the distribution and morphology of these organisms. The caeca from recently killed ducks, turkeys, guinea-hens, geese, squabs, lambs, calves and pigs were obtained and studied. Examinations of caecal contents and scrapings of caecal walls mounted in Ringer's solution were made by means of dark-field illumination. Films of caecal scrapings were stained by the potassium permanganate-gentian violet method of staining spirochetes.[2] All specimens of duck caeca examined showed the presence of spirochetes—long active treponemas, also small delicate treponemas, spironemas and the fusi-spirochaeta types. In several specimens, still warm, these showed extreme activity and indications of transverse division. In turkeys the various forms of spirochetes were also present in all caeca examined. The same was also true of guinea-hens. The specimens of caecal scrapings from geese was markedly different, showing only an occasional spirochete, and many specimens showed none. Squabs showed no spirochetes in the intestinal tract at any point, and caeca were absent. The fresh warm caeca from lambs and calves were negative for spirochetes. In the caeca from pigs there was a variation, but in general spirochetes were only occasionally present in the specimens obtained.

The organisms observed in ducks, turkeys and guinea-hens appeared morphologically like those previously reported in the chickens—the treponemas being up to 0.5 micron in width and varying to about 7 microns in length. The organisms have closely wound spirals, pointed ends, and exhibit great activity. The spironema type is more loosely coiled, 0.75 to 1 micron in width and up to 10 microns in length, has pointed ends, is flexible, but does not possess the great activity of the treponemas. The fusi-spirochaeta forms previously described in chickens were also observed in all specimens containing spirochetes. The specimens of turkey and guinea-hen caeca showed the latter forms in especially large numbers and in a highly active state.

For a morphological study of spirochetes, such as is at present in progress, there is no difficulty whatever in obtaining suitable material, since these organisms may be obtained from a variety of birds. According to our present knowledge, they appear to be non-pathogenic. Although a detailed report on morphological observations is not completed, it might be mentioned that specimens of warm caecal scrapings mounted on a slide (in Ringer's), with a vaseline-sealed coverslip, and kept in a constant temperature chamber at 36° to 38° C., will still show forms of spirochetes, somewhat active after two months, in addition to the granular and other forms commonly observed.[3]

MINNIE B. HARRIS
THE JOHNS HOPKINS UNIVERSITY

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[8] For some of these families we are indebted to Dr. A. S. Wiener.

[1] *Amer. Jour. Hyg.*, Vol. xii, 3, 537–568, November, 1930.

[2] SCIENCE, Vol. lxii, 1863, 275, September 12, 1930.

[3] These studies were begun under a National Research Council Fellowship in Medicine.